

***TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
REMEDATION DIVISION***

**Quality Assurance Project Plan
for the
Superfund Programs**

Q-TRAK # pending

Expiration Date: August 31, 2018

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TCEQ QUALITY ASSURANCE PROJECT PLAN
FOR THE SUPERFUND PROGRAMS

TCEQ APPROVAL (Q-TRAK# pending)

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Date

Signature

Date

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TCEQ QUALITY ASSURANCE PROJECT PLAN
FOR THE SUPERFUND PROGRAMS

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A.0 PROJECT MANAGEMENT

The Texas Commission on Environmental Quality (TCEQ) has prepared this Quality Assurance Project Plan (QAPP) to describe the framework for defining, implementing, and maintaining quality requirements for Brownfields site assessments conducted under the TCEQ/EPA Section 128(a) Cooperative Agreement and for projects using the state Hazardous and Solid Waste Remediation Fund (Fund 5500) under the TCEQ State Superfund Program and the TCEQ Superfund Site Discovery and Assessment Program (SSDAP). This generic QAPP can only be used for sampling activities when it is invoked via an approved field sampling plan (FSP) describing the program, the regulatory framework of the program, the project objectives, the measurement quality objectives for the data needed to meet the project objectives, and the project activities to be conducted under this QAPP. The name and regulatory framework of the program invoking this QAPP and a summary of the site-specific project activities to be conducted under this QAPP is contained in Section 1 of the FSP. Projects funded in full by State Fund 5500 are solely under the direction of the TCEQ Superfund Program. Amendments to this generic QAPP shall be approved by the persons having signatory approval authority for this QAPP.

Guidelines followed in the preparation of this QAPP are:

- EPA Requirements for Quality Assurance Project Plans, Final, EPA QA/R-5 (EPA, latest version)
- EPA Guidance for Quality Assurance Project Plans, Final, EPA QA/G-5 (EPA, latest version)
- EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA, latest version)
- EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA, latest version)
- The most current standards adopted by the National Environmental Laboratory Accreditation Program (NELAP)
- Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA SW-846, most recent update)
- Review and Reporting of COC Concentration Data, TCEQ RG-366/TRRP-13 Regulatory Guidance, latest revision

A.1 *Title and Approval Sheet*

The project-specific title and approval page shall be completed and included in the FSP. An example FSP title and approval page is shown in Figure A.1. For federally-funded projects only, the TCEQ project manager (PM) shall provide a copy of the FSP title and approval page to the TCEQ project quality assurance specialist (project QAS) within three working days from the date of the EPA approval signature.

This QAPP and the site-specific FSP constitute the technical requirements for the project and together specify the policies, organization, functions, and quality assurance and quality control (QA/QC) requirements designed to achieve the project objectives. This QAPP has been prepared to ensure the methods of sample collection, handling, and analysis and the procedures for data review and management are known and documented and the data generated for the project are of known and documented quality. Section 6 of the FSP identifies all additions or modifications to this QAPP necessary to meet the specific project objectives.

Contractors, including laboratories subcontracted to perform analytical methods for the project, shall comply with the procedures documented in this QAPP and the FSP to maintain the comparability and representativeness of the data produced.

When changes to an approved FSP for state-led federally-funded field activities are needed, the TCEQ PM will discuss the changes with the project QAS, the EPA remedial project manager (RPM), and, if appropriate, other members of the project team prior to the initiation of field activities affected by the changes. The changes may be substantive or non-substantive, as determined on a project-specific basis by the EPA RPM.

- If the EPA RPM determines the changes are non-substantive, the TCEQ PM will present the FSP changes in an e-mail (with a copy to the project QAS) requesting the EPA RPM concur with the changes. The TCEQ PM will document the EPA RPM concurrence and will attach the documentation with the agreed upon changes to the FSP.
- If the EPA RPM determines the changes are substantive, the TCEQ PM will amend the FSP and reroute the amended FSP for approval.

Once the TCEQ PM documents EPA RPM concurrence with a non-substantive change, or receives approval signatures from the persons responsible for approving the amended FSP for a substantive change, the TCEQ PM will distribute the approved FSP as follows:

- If the FSP is developed by TCEQ, the TCEQ PM will distribute the non-substantive changes, or the approved amended FSP, to TCEQ staff and Contractor(s) on the FSP distribution list. The Contractor(s) will then distribute the FSP, the non-substantive changes or the approved amended FSP, as specified in QAPP Element A.3.
- If the FSP is developed by a Contractor, the TCEQ PM will send the non-substantive changes or the approved amended FSP to the Contractor for distribution as specified in the QAPP Element A.3.

This QAPP, the site-specific FSP, and all pertinent project documents are required reading for all staff participating in the project.

[Insert Site Name] FIELD SAMPLING PLAN		
As noted by my signature below, I have reviewed the FSP for the project and the Superfund Program QAPP (Q-TRAK#_____). I affirm I understand my responsibilities and my authority for implementing the FSP and QAPP on this project.		
NAME	SIGNATURE	DATE
_____ [Insert Contractor PM name] Project Manager [Insert company name.]	_____	_____
_____ [Insert Contractor QA Officer name] Project QA Officer [Insert company name.]	_____	_____
* _____ [Insert laboratory manager name] Laboratory Manager [Insert laboratory name]	* _____	* _____
_____ [Insert PM name] TCEQ Project Manager	_____	_____
_____ [insert Project QAS name] TCEQ Superfund Project QA Specialist	_____	_____
_____ [insert PC name] TCEQ Superfund Program Coordinator	_____	_____
** _____ [insert RPM name] EPA Remedial Project Manager EPA Region 6	** _____	** _____
<p>* Delete this signature block if a CLP laboratory is used for the project.</p> <p>** Delete this block if EPA approval not required</p>		

Figure A.4.4.1-1 Example Title and Approval Page for FSP

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- ATTACHMENT 1 LABORATORY REVIEW CHECKLIST
- ATTACHMENT 2 EXAMPLE: DATA USABILITY SUMMARY
- ATTACHMENT 3 TCEQ PROJECT MANAGER REVIEW
- ATTACHMENT 4 ELECTRONIC DATA DELIVERABLE FORMAT

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym - Abbreviation	Description
2,4-D	2,4-dichlorophenoxy acetic acid
2,4-DB	4-(dichlorophenoxy) butyric acid
2,4,5-T	(2,4,5-trichlorophenoxy) acetic acid
2,4,5-TP	Silvex
% R	percent recovery
% D	percent difference
ug	microgram
AA	atomic absorption
AO	Administrative Order
ASTM	American Society for Testing Materials
BFB	bromofluorobenzene
BHC	benzene hexachloride
Br ⁻	bromide ion
BTEX	benzene, toluene, ethylbenzene, xylenes
CAS	Chemical Abstract Service
CCB	continuing calibration blank
CCC	calibration check compound
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CF	calibration factor
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	chemical of concern
COD	coefficient of determination (R ²)
CVAA	cold vapor atomic absorption
DCA	dichloroethane
DCB	dichlorobenzene
DCBP	decachlorobiphenyl
DCE	dichloroethene
DCS	detectability check sample
DDD	dichlorodiphenyl dichloroethane
DDE	dichlorodiphenyl dichloroethylene
DDT	dichlorodiphenyl trichloroethane
DFTPP	decafluoro triphenyl phosphine
DOT	Department of Transportation
DUS	Data Usability Summary
ECD	electrolytic conductivity detector
EDB	ethylene dibromide
EICP	extracted ion current profile
ER	Exception Report
F ⁻	fluoride ion
FSP	field sampling plan
FLAA	flame atomic absorption
FS	Feasibility Study
G	glass
GC	gas chromatography

Acronym - Abbreviation	Description
GFAA	graphite furnace atomic absorption
H ₂ SO ₄	sulfuric acid
HCl	hydrochloric acid
ECD	electron capture detector
HNO ₃	nitric acid
IC	ion chromatography
ICAL	initial calibration
ICP/MS	inductively coupled plasma/mass spectrometry
ICP-AES	inductively coupled plasma - atomic emission spectroscopy
ICV	initial calibration verification
IDL	instrument detection limit
IS	internal standard
kg	kilogram
L	liter
LCS	laboratory control sample
LORP	level of required performance
LRC	laboratory review checklist
MB	method blank
MCPA	2-methyl-4-chlorophenoxy acetic acid
MCPP	2-(2-methyl-4-chlorophenoxy) propanic acid
MDL	method detection limit
mg	milligram
ml	milliliter
MQL	method quantitation limit
MS	matrix spike
MSD	matrix spike duplicate
MTBE	methyl tertiary butyl ether
NA	not applicable
Na ₂ S ₂ O ₃	sodium thiosulfate
NaOH	sodium hydroxide
NELAP	National Environmental Laboratory Accreditation Program
NO ₂ ⁻	nitrite ion
NO ₃ ⁻	nitrate ion
NPL	National Priorities List
NTU	nephelometric turbidity units
O&M	Operations and Maintenance
P	polyethylene
PAHs	polynuclear aromatic hydrocarbons
PB	preparation blank
PCBs	polychlorinated biphenyls
PCE	perchloroethene
PID	photoionization detector
PM	Project Manager
PO ₄ ³⁻	phosphate ion
PRP	Potentially Responsible Party
QA	quality assurance
QAP	Quality Management Plan
QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Specialist

Acronym - Abbreviation	Description
QC	quality control
r	correlation coefficient
RA	Remedial Action
RD	Remedial Design
RF	response factor
RI	Remedial Investigation
RPD	relative percent difference
RRT	relative retention time
RSD	relative standard deviation
RT	retention time
SDL	sample detection limit
SO ₄ ⁻	sulfate ion
SOP	standard operating procedure
SPCCs	system performance check compounds
SPLP	Synthetic Precipitation Leaching Procedure
SSDAP	Texas Superfund Site Discovery and Assessment Program
SW	SW846
SWDA	Solid Waste Disposal Act
TAC	Texas Administrative Code
TCA	trichloroethane
TCDD	tetrachloro-dibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compound
TWC	Texas Water Code
VOC	Volatile Organic Compound
VCP-CA	Voluntary Cleanup Program - Corrective Action Section

A.3 Distribution List

The TCEQ Lead QAS for the Superfund Program and the Brownfields Program (lead QAS) will provide a bound hard copy and an electronic copy of this approved generic QAPP to the EPA Region 6 Superfund QA Officer and the following TCEQ staff and management:

- TCEQ QA manager, Monitoring Operations Division,
- Waste QAS, Monitoring Operations Division,
- Director, Remediation Division,
- Division Support Section manager,
- Superfund project QAS,
- Brownfields project QAS,
- Superfund Section manager,
- Superfund Program coordinators,
- VCP-CA Section manager,
- Brownfields program manager and grant manager.

The State Superfund program coordinator will provide TCEQ Contractors and Superfund staff with an internet link on the external Remediation Division webpage to the electronic copy of the approved QAPP. The Brownfields program manager will provide the webpage link for the electronic copy of the approved QAPP to Brownfields Program staff. The Contractor, as identified in the FSP, shall implement controlled distribution of the QAPP and FSP, and any subsequent revisions, to ensure the current version is being used. The project-specific distribution list shall include the TCEQ PM, the Contractor PM, the Contractor project QA officer, and the subcontractors, including laboratory managers for non-CLP laboratories. The project-specific distribution list for controlled copies is maintained by the Contractor and is included in the FSP.

The Contractor shall use a sequential numbering system to identify the assigned recipient of each controlled copy of the QAPP and FSP. The Contractor shall ensure all persons holding a controlled copy of the QAPP shall receive the FSP revisions/additions, and outdated material is removed from circulation and archived. The document control system does not preclude making and using copies of the QAPP; however, the holders of controlled copies are responsible for distributing additional material to update any copies within their organizations.

A.4 Project/Task Organization

Section 1 of the FSP describes the project and task(s) organization, contains the project organization chart, identifies the key individuals of the project team (e.g., the principal data user(s), the decision-maker, PMs, QASs, and other persons responsible for implementing the QAPP), and lists any additional role(s) and responsibilities specific to the project for each of these individuals.

The organization chart includes: 1) the lines of authority for the project, including internal lines of authority; 2) the lines of communication for the project, including lines of communication within and between organizations; and 3) the telephone number, physical location (i.e., city and state), and organizational title for each individual. The organization chart identifies the project QAS, documents the project QAS is independent of the individuals and team collecting, generating, and/or using the data, and documents the project QAS has a direct line of communication with Remediation Division management. Where direct contact between key individuals for the project does not occur, such as between a project consultant for a potentially responsible party and the TCEQ risk assessment staff, the project organization chart shows the route by which information is exchanged. The individuals with signatory approval responsibility are identified in the organization charts.

The entities and individuals involved in collecting, analyzing, assessing, processing, and reporting data for the project are responsible for ensuring these activities are carried out in accordance with the provisions of this QAPP and the FSP, TCEQ rules and policies, other applicable state, federal or local laws and applicable guidance documents. Section 6 of the FSP specifies the procedures to follow when deviations from the approved project plans are made in the field.

A.4.1 TCEQ Superfund Section Manager

The TCEQ Superfund Section manager is responsible for managing the state Superfund Program, the federal Superfund program, and the SSDAP and is accountable for the successful completion of program-related tasks and objectives. The Superfund Section manager performs the following tasks:

- maintains a thorough knowledge of program activities, commitments, deliverables, and time frames;
- develops necessary lines of communication and good working relationships between the lead division staff and personnel of other divisions and organizations participating in the program;
- selects PMs;
- monitors the effectiveness of the program quality system;
- provides feedback to supervisory and administrative personnel as necessary regarding the performance of the grant and PMs;
- advises supervisory personnel when program timetables, tasks, and coordination procedures are not being met;
- elevates problems and issues requiring resolution to the Division Director, or designee(s), for disposition, when appropriate;
- executes contracts and, as necessary, intergovernmental agreements; and
- serves as point of contact with management counterparts at the EPA.

The Superfund Section manager has the authority to develop and implement the quality systems for the state Superfund program, the federal Superfund program, and the SSDAP, including the development and maintenance of this QAPP. The Superfund Section manager will develop these systems with the concurrence and assistance of the lead QAS.

The Superfund Section manager is responsible for ensuring environmental activities funded by Fund 5500 are performed in accordance with applicable plans and procedures, work performance is measured against specifications, and appropriate management oversight and inspection is accomplished. The Superfund Section manager is also responsible for improving the systems relating to the state and federal Superfund programs and the SSDAP and ensuring deficient items and services are evaluated and controlled (i.e., inadvertent use or adverse impact on other items and services is prevented), root cause(s) of deficiencies and nonconformances are determined, and corrective actions are planned, implemented, and verified in a timely manner.

A.4.2 Voluntary Cleanup Program/Corrective Action Section Manager

The VCP-CA Section manager is responsible for managing TCEQ staff performing Brownfields Program activities and for ensuring environmental activities within the Brownfields Program are performed in accordance with applicable plans and procedures, work performance is measured against specifications, and appropriate management oversight and inspection is accomplished. The VCP-CA Section manager, or designee, assesses competency of contractors via an established contractor evaluation process and assesses competency of Brownfields staff working on federally-funded projects via an established performance review process.

A.4.3 Brownfields and Superfund Program Managers

The TCEQ Brownfields and Superfund program managers are responsible for managing the federal Brownfields Program and the Superfund Program, respectively, and are accountable for the successful completion of program-related tasks and objectives. The program managers perform the following tasks:

- serve as point of contact with management counterparts at the EPA;
- maintain a thorough knowledge of program work activities, commitments, deliverables, and time frames;
- develop necessary lines of communication and good working relationships between the lead division staff and personnel of other divisions and organizations participating in the program;
- select PMs;
- monitor the effectiveness of the respective program quality system;

- provide feedback to applicable team leader, section manager, and/or division director as necessary regarding the performance of the grant and PMs;
- advise supervisory personnel when program timetables, tasks, and coordination procedures are not being met;
- elevate problems and issues requiring resolution to the Superfund Section manager or the VCP-CA Section manager, or designee(s), for disposition, when appropriate;
- evaluate the competency of contractors via an established contractor evaluation process; and
- execute contracts and intergovernmental agreements.

The program managers have the delegated authority to develop and implement the quality systems for the federal Brownfields and Superfund programs, including the development and maintenance of this QAPP. The program managers shall develop these systems with the concurrence and assistance of the lead QAS.

The program managers are responsible for ensuring environmental activities within the federal Brownfields and Superfund programs are performed in accordance with applicable plans and procedures, work performance is measured against specifications, and appropriate management oversight and inspection is accomplished. The program managers are also responsible for improving systems relating to the federal programs and ensuring deficient items and services are evaluated and controlled (i.e., inadvertent use or adverse impact on other items and services is prevented), root cause(s) of deficiencies and nonconformances are determined, and corrective actions are planned, implemented, and verified in a timely manner.

A.4.4 TCEQ Superfund Program Coordinators

A.4.4.1 *TCEQ Federal Superfund Program Coordinator*

The Federal Superfund Program Coordinator is responsible for the following:

- coordinating:
 - multi-year/multi-site program schedules and goals,
 - the EPA five-year review program,
 - post construction phases of work,
 - EPA training and other training associated with federal Superfund sites, and
 - with EPA on Superfund State Contracts;
- providing program and technical expertise;
- monitoring EPA activity affecting federal Superfund sites;
- developing, maintaining, and promoting program infrastructure; and
- serving as a liaison for funding, grant, contract, and budget issues.

A.4.4.2 *TCEQ State Superfund Program Coordinator*

The State Superfund Program Coordinator is responsible for:

- coordinating:
 - multi-year/multi-site schedules and goals,
 - the five-year review program, and
 - post construction completion phases of work;
- providing program and technical expertise;
- reviewing and approving FSPs and referring them to the project QAS for review and approval;
- developing, maintaining, and promoting program infrastructure;
- distributing this QAPP to Superfund Section staff and TCEQ Contractors;
- posting an accessible electronic version of the approved QAPP on the TCEQ Remediation Division internal and external website; and
- serving as a liaison for funding, contract, and budget issues.

A.4.4.3 *TCEQ Superfund Site Discovery and Assessment Program Coordinator*

The Superfund Site Discovery and Assessment Program Coordinator is responsible for:

- coordinating site referrals and assignments;
- prioritizing sites for evaluation;
- providing program and technical expertise;
- reviewing and approving FSPs and referring them to the project QAS for review and approval;
- developing, maintaining, and promoting program infrastructure; and
- serving as a liaison for funding, contract, budget issues and interactions with the lead QAS, the project QAS, and office of Legal Services.

A.4.5 *TCEQ Project Quality Assurance Specialist*

The project QAS serves as a resource on analytical chemistry and QA/QC issues. The responsibilities of the project QAS include:

- reviewing of the QAPP and associated FSP;
- conducting assessment activities, including management system reviews and technical systems audits, and monitoring the implementation of corrective actions;
- providing technical assistance in the resolution of QA/QC or analytical chemistry issues; and

- reviewing data packages and data usability summary (DUS) reports at the request of the TCEQ PM. (Note: The responsibilities of the project QAS do not include data validation, which is the responsibility of the TCEQ Contractor.)

If requested, the project QAS will review the draft data packages and DUS to verify data collection was properly conducted and documented, problems have been satisfactorily resolved and documented, and data review and validation have been performed in accordance with this QAPP.

Any problems discovered during review of the data packages or DUS by the project QAS will be reported to the TCEQ PM. The project QAS will be available to assist the TCEQ PM in the resolution of any problems and corrective actions. The data review responsibilities of the project QAS are specified in Element D.3.2.

A.4.6 TCEQ Project Manager

The TCEQ PM is the primary point of contact within the TCEQ for all site related issues. The PM is responsible for the overall direction and implementation of the project in accordance with the provisions of this QAPP and the FSP and the oversight of contractors and field work.

The responsibilities of the TCEQ PM specific to data quality include:

- Establishing the project objectives, implementing and coordinating the systematic planning process, and communicating the results to the project team;
- directing the Contractor to use a TCEQ contracted laboratory, a subcontracted laboratory, or a laboratory participating in the EPA Superfund Contract Laboratory Program (CLP), as appropriate;
- reviewing and approving the FSP, field activities, reports, and other data;
- collecting samples, or providing oversight of a TCEQ Contractor collecting samples, for the TCEQ;
- verifying data submitted to the TCEQ are collected, analyzed, evaluated, and documented according to the requirements of this QAPP;
- distributing the project documents, including the QAPP and FSP, to the TCEQ Central Records and site repositories as part of the site files in the local area of the site;
- explaining the requirements of the Superfund QA program to TCEQ Contractors and ensuring TCEQ Contractors comply with the requirements, through review of reports documenting field activities and/or direct oversight of field work; and
- final approval of the analytical chemistry data based upon his/her review and, if applicable to the project, the recommendations of the project QAS;
- on federally-funded projects, evaluating the competency of contractors via an established contractor evaluation process and maintaining documentation of

contractor competency in accordance with the applicable Superfund contract specification; and

- communicating and coordinating with the public, other governmental entities, and other interested parties, as required.

Project oversight responsibilities for the TCEQ PM are specified in Element C.1. The data review responsibilities of the TCEQ PM are specified in Element D.3.1.

A.4.7 TCEQ Brownfields and Superfund Lead Program Quality Assurance Specialist

The lead QAS is responsible for assisting the Superfund program coordinators and Superfund Section manager and the Brownfields program manager and the VCP-CA Section manager in the development and implementation of the Superfund QA program and Brownfields QA program, respectively. The specific duties of the lead QAS are defined in Appendix C of the TCEQ Quality Management Plan (QMP), as amended. The lead QAS performs QA/QC tasks including, but not limited to, the following:

- participates in the development, approval, implementation, and maintenance of written QA standards, e.g., quality management plans (QMPs), standard operating procedures (SOPs), and QAPPs;
- assists program and PMs in developing and implementing quality systems;
- participates in the preparation of quality reports (e.g., annual reports);
- prepares and distributes annual assessment plans;
- determines conformance with program quality system requirements;
- determines the lead assessor for assessments;
- recommends through the PM, the program coordinator/manager, the Division Support Section manager, and the Superfund or VCP-CA Section manager to the division director, that work be stopped to safeguard programmatic objectives, worker safety, public health, or the environmental;
- evaluates and concurs with proposed corrective actions and the means by which corrective actions will be documented and verified;
- receives and maintains assessment records;
- monitors the implementation of corrective actions;
- identifies positive and adverse trends in program quality systems;
- reports on the status of corrective action programs;
- provides technical expertise and/or consultation on quality services;
- assesses the effectiveness of program quality systems;
- verifies the competency of contractors and TCEQ staff working on federally-funded projects is evaluated and documented; and

- prepares and forwards an annual QA report to the Quality Assurance Manager.

The lead QAS may also perform some or all of the following QA/QC tasks:

- coordinates the identification, disposition, and reporting to management of nonconforming items and activities;
- participates in data quality assessments;
- coordinates quality training; and
- serves as a quality system representative on special forums and committees.

The lead QAS reports to the TCEQ Remediation Division Technical Program Support team leader. As necessary to identify quality-related problems and ensure timely and effective corrective action, the lead QAS has direct access to the section managers for the FSF and Brownfields programs, the division director, and the agency QA manager.

The lead QAS is responsible for distributing the QAPP according to Element A.3.

A.4.8 Contractor Responsibilities

The Contractor is responsible for communicating the project objectives and measurement quality objectives to all subcontractors, including the laboratory. As stated above, the default measurement quality objectives are specified in method-specific tables in Element B.5. The Contractor shall determine if the laboratory can meet the proposed project and measurement objectives. Other Contractor responsibilities specific to the project are detailed in Section 1 of the FSP.

A.4.8.1 *TCEQ Contractor Project Manager*

The TCEQ Contractor PM is responsible for:

- reviewing and approving the FSP;
- distributing the FSP, and any revision(s), and the QAPP to Contractor staff and subcontractor staff performing activities under the FSP;
- securing the laboratory signature documenting laboratory review of the analytical specifications in the QAPP and FSP and confirming the laboratory can meet the analytical project objectives;
- monitoring the laboratory for compliance with the project requirements and schedule;
- performing, reviewing, and managing work, including work performed by subcontractors, to verify compliance with the applicable contract, work order, QAPP and FSP;
- communicating with the TCEQ PM;
- completing objectives as tasked by the TCEQ PM in accordance with the applicable contract;

- on federally funded projects, documenting the competency of their personnel and all subcontracted parties, maintaining the documentation during the active and archived life of the project, and making the documentation available to the TCEQ for review; and
- overseeing and communicating with subcontractors.

A.4.8.2 *Contractor Field Manager*

The contractor field manager is responsible for:

- field implementation of the FSP;
- direction of all field activities described in this FSP;
- communicating with the Contractor PM; and
- stopping field work if safety or data quality are significantly affected.

A.4.8.3 *Contractor QA Officer/Data Reviewer*

The contractor QA officer/data reviewer is responsible for:

- reviewing and qualifying project analytical data in accordance with the QAPP;
- preparing the data review and data validation memoranda and DUS associated with the project; and
- prescribing, implementing, and monitoring the corrective actions to address analytical chemistry and QA/QC issues.

A.4.8.4 *Responsibilities of the Laboratory*

The laboratory shall be accredited through the Texas Laboratory Accreditation Program for conformance to the most current standards adopted by the National Environmental Laboratory Accreditation Program and the requirements in 30 TAC 25. The accreditation will be for the matrices, methods, and parameters of analysis. The TCEQ can waive this requirement in writing if one of the regulatory exceptions in 30 TAC §25.6 applies to the laboratory, the data, or the project. Prior to receiving samples from a TCEQ Superfund and Brownfields project, the laboratory must apply for and receive accreditation through the TCEQ for the matrices, methods, and parameters of analysis. The laboratory is responsible for maintaining conformance to the current standards adopted by NELAP.

If the laboratory resides in Texas, the laboratory must receive primary accreditation through the TCEQ. Laboratories that do not reside in Texas must apply for and receive primary accreditation from their resident state (unless the resident state waives primary accreditation) and secondary accreditation from TCEQ or must apply for and receive primary accreditation from TCEQ. Laboratories residing in states without an accreditation program may obtain primary accreditation from any National

Environmental Laboratory Accreditation Program state and secondary accreditation from TCEQ.

The laboratory is responsible for reviewing this QAPP and the FSP to ensure that the laboratory is capable of generating data that will meet the project objectives. The project team should identify the analytical/measurement objectives for the project. The default analytical quality objectives are specified in Element B.5. The laboratory can propose to the Contractor to modify these default objectives, based upon the laboratory's routine analytical performance for the specified methods and matrices. If these modifications are approved by the project team, the modifications shall be documented in Section 6 of the FSP. The laboratory should be familiar with the sections within the FSP that are referenced in the QAPP concerning the performance standards for the laboratory. If the QAPP does not contain the information needed by the laboratory, the laboratory shall contact the Contractor who in turn will contact the TCEQ QAS identified on the approval page. The laboratory responsibilities associated with project-specific reporting procedures are specified in Element A.9 of the QAPP, and the laboratory's responsibility for data review is addressed in Element D.2.1.1 of the QAPP.

A.4.8.4.1 Laboratory Manager

The laboratory manager is responsible for:

- overseeing the laboratory activities;
- verifying laboratory activities are conducted in accordance with the QAPP and laboratory QA policies and procedures; and
- submitting analytical data packages and other reports according to the project schedule.

A.5 Problem Definition/Background

The definition of the problem and the background for the project is outlined in the following sections of the FSP:

- Section 1 includes a description of the problem as currently understood, the importance of the project, and the programmatic and regulatory context for the project and identifies the principal data user or decision maker and the project goals and objectives.
- Section 2 includes the conceptual site model and a summary of existing information sufficient to provide a historical, scientific, and regulatory perspective for the project. Section 2 also identifies any uncertainties (e.g., data gaps) to be addressed by the project task(s) described in Element A.6.

A.6 Project/Task Description

Section 1 of the FSP contains the project schedule and a summary of the planned activities and the project tasks. Section 1 also includes descriptive information for:

- the characteristics or properties to be studied and the measurement processes and techniques to be used;
- the regulatory standards and/or criteria pertinent to the project;
- special personnel or equipment required for the specific type of work being planned or for the specific type of measurements being taken;
- the project schedule for implementation of work to be performed and the associated work products to be produced as specified in the work order; and
- if required for the project, the degree of quality assessment activity needed for the project, a discussion of the timing of each planned assessment, and a brief outline of the roles of the different parties involved. The degree of assessment activity (e.g., frequency of audits) depends upon the complexity, duration, and objectives of the project (see Element C.1 of the QAPP).

A description of project and QA record requirements, including those requirements for field operation records, laboratory data packages and turn-around time requirements, document retention time and location, reporting format, and document control are contained in Element A.9.

A.7 Quality Objectives and Criteria

The type, quality, and quantity of data needed for the specific project shall be defined. Default accuracy and precision limits are specified in Elements B.5.1 and B.5.2. The completeness requirement is 95 percent for aqueous samples and 90 percent for soil and sediment samples. The Contractor will review the data quality and sensitivity requirements for the project and will compare these requirements against the default specifications given in Element B.5 of this QAPP. Based on that comparison, the Contractor will identify the project-specific changes needed and verify the laboratory is capable of meeting the project specifications. The Contractor will document in Section 6 of the FSP the changes needed to meet the project objectives (such as lower or higher method quantitation limits, different analyte lists, or additional analytical methods not specified in this QAPP).

If required for the project, Section 6 of the FSP includes a specification for the laboratory to spike the laboratory control sample (LCS) and/or matrix spike/matrix spike duplicate (MS/MSD) at a concentration at, or below, the level of required performance or regulatory limit for the known or suspected chemicals of concern (COCs).

Detected results greater than the method detection limit (MDL) that meet the qualitative identification criteria specified in the analytical method shall be adjusted for sample specific factors (e.g., sample characteristics, sample preparation, and/or laboratory adjustments) and reported. The results detected between the MDL and the method quantitation limit (MQL) shall be flagged to indicate the compound is present but the reported value is estimated. Non-detected results shall be reported as less than the value of the sample detection limit (SDL). The SDL is the MDL adjusted for sample specific factors, e.g., sample characteristics, sample preparation, and/or laboratory adjustments and reported as less than the value of the SDL (e.g., "< 5 ug/L" or "5 ug/L U"). For results initially "E" flagged by the laboratory to denote the reported value exceeds the upper quantitation limit, the laboratory will reanalyze the sample using an appropriate dilution factor.

A.8 Special Training/Certification

The laboratory analyzing project samples will be accredited through the Texas Laboratory Accreditation Program for conformance to the most current standards adopted by the NELAP and conformance to the requirements in 30 TAC 25.

Section 1 of the FSP specifies the special or non-routine training/certification needed for the project. Certificates or documentation representing completion of specialized training shall be maintained in the personnel files of the respective employer during the active and archived life of the project.

On federally-funded projects, the Contractor is responsible for documenting the competency of their personnel and all subcontracted parties. The Contractor will maintain documentation of competency in the field(s) of expertise (e.g., current participation in accreditation or certification programs, personnel resumes, certification and training records of key personnel, organizational chart and position descriptions showing pertinent staff with major responsibilities and qualifications) in the project files during the active and archived life of the project. On federally-funded projects, the TCEQ staff shall maintain documentation of Contractor competency (e.g., qualifications of key personnel, evaluation of past contractor performance on similar scope of work) in accordance with the applicable contract specifications.

On federally-funded projects, the Brownfields program management will document the competency of Brownfields program staff and will maintain the documentation on file and readily available for review.

On federally-funded projects, the Brownfields Program management and the Brownfields lead QAS will verify the evaluation of competency of Contractors is performed through the established contractor evaluation process and the evaluation of competency of Brownfields Program staff is performed through the established performance review process.

A.9 Documents and Records

A.9.1 Field Operation Records

Field personnel will use bound, pre-paginated field notebooks and permanent ink to record field measurement data and associated reference procedures, daily field activities, and any deviations from planned activities. The field personnel will sign and date each page. When an entry is made in error, the field personnel will use a single line to strike the error and will initial and date the correction. The field operations records shall document overall field operations and comprise, but not be limited to, the following:

- Sample collection records. These records shall document the sampling protocol performed in the field. At a minimum, this documentation should include:
 - the activity being performed,
 - the names of the persons conducting the activity,
 - sample number,
 - sample collection points,
 - identification of sampling equipment/method used,
 - the identity of each sample and depth(s) from which it was collected,
 - the amount of each sample,
 - sample description (e.g., color, odor, clarity),
 - the date and time of sample collection,
 - maps and diagrams,
 - site photographs,
 - visitors to the site,
 - climatic conditions, and
 - unusual observations or conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged well casings).
- Custody records. Custody records shall be used to document the progression of samples as they travel from the original sampling location to the laboratory and to final disposition. Custody procedures are described in Element B.3.
- QC sample records. These records shall document the generation of QC samples, such as field, trip, equipment rinsate blanks, and field duplicate samples. The records shall also include documentation of sample integrity and preservation, field instrument calibration, and standards traceability documentation capable of providing a reproducible reference point. Quality control sample records shall contain information on the frequency, conditions, level of standards, and instrument calibration history.

- General field procedures. These records shall document general field procedures used in the field to gather data, including the procedures used in areas where it was difficult to collect samples.
- Field corrective action reports. Field corrective action reports shall document the methods used when general field practices or procedures specified in the standard operating procedures were not followed. The field corrective action reports shall include the methods used to resolve a noncompliance.

A.9.2 Direct or Subcontracted Laboratory Data Package

If a CLP laboratory or the EPA Region 6 laboratory is used for analyzing project samples, refer to Element A.9.4. The laboratory data package submitted to the TCEQ PM shall contain the laboratory review checklist(s) (LRCs), as described in Element A.9.2.1, and the required reportable data, as described in Element A.9.2.2. In addition, the laboratory data package shall clearly indicate the accreditations, issued to the laboratory by the TCEQ, include the matrices, methods, and parameters of analysis related to the project data contained in the data package. When electronic data deliverables are requested by the TCEQ, the laboratory electronic data deliverables will be editable Microsoft Excel files containing the fields listed in Attachment 4.

A.9.2.1 *Laboratory Review Checklists*

The laboratory shall complete LRCs that substantively meet the specifications outlined in the example LRC included in Attachment 1 of this QAPP. The laboratory data package shall include the LRCs and the reportable data identified in Element A.9.2.2. The laboratory can elect to complete the LRC(s) on a batch basis, project basis, or laboratory-defined basis provided that each LRC clearly and unambiguously lists the project samples associated with that LRC. The LRC shall be substantively complete enough to provide an independent reviewer with enough information to be able to independently assess the magnitude of the potential inaccuracy or imprecision, the direction of potential bias, and other potential effects on the quality or documentability of the reported results based on the technical review by the laboratory.

A.9.2.1.1 Exception Reports

Each LRC shall contain an Exception Report (ER) for each “No” or “NR” (i.e., not reviewed) entry on the LRC. The associated ERs shall identify any problems or anomalies the laboratory observed during the receipt, handling, preparation, and/or analysis of a sample. The ERs shall briefly but concisely include the identification and description of all deviations from the analytical method, the laboratory quality assurance plan (QAP) and SOPs, and Element B.5 of this QAPP. The ERs shall also include identification of all instances in which QC measure results failed to meet acceptance criteria along with a brief, but complete, description of the QC measure involved, the acceptance limit, and the value for the QC measure that was outside of acceptance limits. Descriptions in the

ERs should include the samples affected by the problem(s)/anomalies and the direction and estimated magnitude of the bias, if possible.

A.9.2.1.2 Release Statement

Each LRC shall contain a release statement that shall be signed by the laboratory manager or his designee. Unless otherwise approved by the TCEQ, the release statement text shall read:

“I am responsible for the release of this laboratory data package. This laboratory is accredited under the Texas Laboratory Accreditation Program for all the methods, analytes, and matrices reported in this data package except as noted in the Exception Reports. The data have been reviewed and are technically compliant with the requirements of the methods used, except where noted by the laboratory in the Exception Reports. By my signature below, I affirm to the best of my knowledge all problems/anomalies observed by the laboratory have been identified in the LRC, and no information affecting the quality of the data has been knowingly withheld.”

The release statement shall include the printed name and official title and the signature of the person signing the statement and shall include the date of the signature.

A.9.2.2 *Required Reportable Data*

The laboratory data package released by the laboratory (the Laboratory Data Package) shall contain those items listed on the signature page of the LRC in Attachment 1. Specifications of the reportable data to be delivered within the laboratory data package are outlined below. A brief summary of these requirements is also provided below. The “(R#)” notations are provided to match those used in the example LRC included in Attachment 1.

The required reportable data are:

- Completed custody documentation (R1)
- Sample identification cross-reference (R2)
- Test reports for samples (R3)
- Surrogate recovery data (R4)
- Laboratory blank sample data (R5)
- Laboratory control sample (LCS) data (R6)
- Matrix spike/matrix spike duplicate (MS/MSD) data (R7)
- Analytical duplicate data (R8)

- Method quantitation limits and detectability check sample results and the laboratory's NELAP certificate(s), including the associated issue date(s) and expiration date(s), for the analyses reported in the laboratory data package (R9)
- Other problems and/or anomalies observed by the laboratory (R10)

A.9.2.2.1 Completed Custody Documentation (R1)

The laboratory data package shall include copies of the completed custody forms and documentation. Information to be supplied includes field sample identification, method of preservation, analytical methods requested and/or analytes requested, signatures of all personnel having custody of the samples prior to delivery to the laboratory, signature of laboratory personnel receiving samples, sample condition upon receipt including temperature upon receipt, presence/condition of custody seals on coolers/samples, laboratory assigned job number and sample numbers, and other pertinent log-in information, as applicable, such as missing samples, broken containers, etc. The custody documentation reported in the package shall include a copy of the custody form used by the field personnel, and may also include forms which the laboratory uses to document condition upon receipt.

A.9.2.2.2 Sample Identification Cross-Reference (R2)

The laboratory data package shall include a listing of all field sample identification numbers (sorted alphanumerically) cross-referenced to the associated laboratory sample identification numbers. This listing shall also include the laboratory batch number(s) associated with each sample analysis reported in the data package. The data package shall include an easy and unambiguous means by which all of the field samples associated with a specific QC sample (e.g., the laboratory duplicate, the MS/MSD samples, and the laboratory control sample) can be identified.

A.9.2.2.3 Test Reports for Samples (R3)

The laboratory data package shall include the annotated test reports for all samples including field samples, dilutions, reanalyses from which data are being reported, method/preparation blanks, MS/MSDs (or laboratory duplicates), and laboratory control samples. Analytical results shall be reported on a dry weight basis for soil and sediment samples with the percent solids (or percent moisture) also reported on the test reports to allow back-calculation of the result on a wet weight basis. The test report shall include all information noted on the signature page of the LRC (see Attachment 1 of this QAPP). Non-detected results shall be reported as specified in Element A.7.

A.9.2.2.3.1 Tentatively Identified Compounds

If the reporting of Tentatively Identified Compounds (TICs) is specified in Section 6 of the FSP for volatile or semivolatile organic compound analysis by GC/mass spec, requirements associated with TIC identification and quantitation shall be met. These

requirements are specified below in the paragraphs that follow. For each sample, the sample test report or the TIC identification summary report shall include the following for each TIC: 1) the CAS number; 2) the compound name; 3) the retention time; and 4) the estimated concentration. When TICs are required, the laboratory data package shall include chromatograms, spectral comparisons, computer generated data on the closeness of the match, and the analyst's TIC identification.

Requirements for TIC reporting are as follows. A library search shall be executed for non-target organic sample components for the purpose of tentative identification. The organic compounds of greatest apparent concentration not listed in Tables B.5.1.9-1 and B.5.1.10-1 for the volatile organic fraction or for the semivolatile fraction, respectively, excluding the system monitoring compounds and internal standard compounds, shall be tentatively identified. The tentative identification shall be conducted via a forward search of the National Institute of Standards and Technology (NIST), EPA, or National Institute of Health (NIH) (May 1992 release or later) and/or Wiley (1991 release or later), or equivalent mass spectral library. Only after visual comparison of sample spectra with the nearest library searches will the mass spectrometrists assign a tentative identification. NOTE: Computer generated library search routines must not use normalizations which would misrepresent the library or unknown spectra when compared to each other.

Guidelines for making tentative identification include:

- Relative intensities of major ions in the reference spectrum (ions greater than 10 percent of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within ± 20.0 percent. Example: For an ion with an abundance of 50.0 percent of the reference spectra, the corresponding sample ion abundance must be between 30.0 and 70.0 percent.
- Molecular ions present in reference spectrum should be present in sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination, interference, or presence of coeluting compounds.
- Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting compounds. Data system library reduction programs can sometimes create these discrepancies.
- For multi-peak materials (e.g., gasoline or mineral spirits) which are not calibrated, but are easily recognized, all the peaks related to the material should be reported as a single TIC, not as individual peaks, such as methylpentane, hexane, etc.
- Performing a library search for non-target volatile organic sample components for the purpose of tentative identification. Up to 10 volatile organic compounds of

greatest apparent concentration not listed in Table B.5.1.9-1 for the volatile organic fraction shall be reported. The following are not to be reported for volatile analyses: (1) substances with responses less than 10 percent of the internal standard (as determined by inspection of the peak areas or height); (2) substances which elute earlier than 30 seconds before the first purgeable compound or three minutes after the last purgeable compound listed in Table B.5.1.9-1 has eluted; (3) carbon dioxide; and (4) semivolatile target compounds listed in Table B.5.1.10-1.

- Performing a library search for non-target semivolatile organic sample components for the purpose of tentative identification. Up to 20 semivolatile organic compounds of greatest apparent concentration not listed in Table B.5.1.10-1 for the semivolatile organic fraction shall be reported. The following are not to be reported for semivolatile analyses: (1) substances with responses less than 10 percent of the internal standard (as determined by inspection of the peak areas or heights); (2) substances which elute earlier than 30 seconds before the first semivolatile compound or three minutes after the last semivolatile compound listed in Table B.5.1.10-1 has eluted; and (3) volatile compounds listed in Table B.5.1.9-1. Peaks that are suspected to be aldol-condensation reaction products (i.e., 4-methyl-4-hydroxy-2-pentanone and 4-methyl-3-pentene-2-one) shall be searched, reported, and counted as part of the 20 most intense non-target semivolatile compounds, and qualified with an "A" flag on the laboratory report. The laboratory shall also report pesticide target compounds listed in Table B.5.1.5-1 that appear as semivolatile tentatively identified compounds.
- Additionally, up to 20 semivolatile alkane/alkene peaks of greatest apparent concentration (as determined by inspection of peak areas or heights) that are suspected to be straight-chain, branched, or cyclic alkanes, alone or part of an alkene series shall be library searched. Documentation for the tentative identification must be supplied. When alkanes are tentatively identified, the concentrations are to be estimated and reported in the LRC as alkanes by class (i.e., straight-chained, branched, or cyclic). Peaks that are suspected to be part of an alkane series (e.g., C5-C9) may be library searched and reported as a single entry with an estimate given for the total concentration of the series.

A.9.2.2.4 Surrogate Recovery Data (R4)

The laboratory data package shall include the surrogate data as applicable to the analytical method performed. The surrogate can be included on the test report for each sample, or can be included on a separate sheet, provided that the surrogate results are clearly and unambiguously linked to the sample from which the results were measured. The surrogate data shall include the percent recovery between the amount added and the amount measured and the laboratory's quality control limits, as documented on the laboratory's control charts.

A.9.2.2.5 Laboratory Blank Sample Data (R5)

The laboratory data package shall include test reports or summary forms for all blank samples (e.g., method and preparation blanks) pertinent to the sample analyses. If a target analyte was detected in any of the blanks associated with an analytical and/or preparation batch that includes samples from the project, the type of blank, the level of the contamination, the environmental samples affected, and the potential effect on the associated data shall be described in an ER.

When the concentration of a COC (unadjusted for sample specific factors) in one or more of the environmental samples is greater than or equal to 10 times the concentration in one or more associated laboratory blank samples (e.g., system, method, preparation, or calibration), the laboratory will flag the analytical result and generate an exception report to identify the blank sample type(s) and the environmental sample(s) affected to advise the data user of sample results not likely affected by blank contamination.

Blank sample test reports should contain all of the information required for sample test reports (e.g., surrogate recoveries). Sample data should not be blank corrected. Results for blank analyses for which the blank does not go through the method preparation and extraction procedures (e.g., solvent blanks, system blanks, calibration blanks) may be reported on blank summary forms instead of on test reports.

A.9.2.2.6 Laboratory Control Sample Data (R6)

The laboratory data package shall include the LCS test reports or LCS results summary forms. The LCS shall be taken through the entire preparation, cleanup, and analysis procedure. The LCS samples shall contain all chemicals of concern identified in Section 3 of the FSP. When the chemicals of concern are not identified for the project, the LCS shall contain all analytes for which data are reported. The LCS test report, or LCS results summary form, shall include the amount of each analyte added to the sample, the amount measured during the analysis, the percent recovery (%R) between the amount added and the amount measured, and QC limits for each analyte in the LCS. If specified in Section 6 of the FSP, the LCS shall be spiked at, or below, the analytical level of interest. If applicable to the laboratory's QAP and/or SOPs, the %R and relative percent difference (RPD) data for each analyte in the laboratory control sample duplicate (LCSD) shall be reported.

A.9.2.2.7 Matrix Spike/Matrix Spike Duplicate Data (R7)

The laboratory data package shall include the MS/MSD test reports or summary forms. The MS/MSD samples shall be spiked with all chemicals of concern identified in Section 3 of the FSP. When the chemicals of concern are not specified for the project, the MS/MSD shall be spiked with a subset of the analytes included in the laboratory's initial calibration standard mixture(s) that are representative of the range and characteristics

of the calibrated analytes. The MS/MSD test reports or results summary forms shall include identification of the compounds in the spike solution, the amount of each compound added to the MS and the MSD, the parent sample concentration, the concentration measured in both MS and MSD, the calculated percent recovery (%R), RPD, and the QC limits for both %R and RPD. The form shall also include the laboratory batch number and the identification number of the sample spiked. The data package shall include an easy and unambiguous means by which the samples associated with that particular MS/MSD can be identified, such as a sample identification cross-reference table.

The LRC or MS/MSD summary form shall identify whether the sample selected for the MS/MSD analyses was from the project. If a non-project sample is used for the MS/MSD analysis, an ER shall provide the justification (e.g., "Non-project sample spiked. Lab received insufficient project sample volume for MS/MSD"). When either, or both, MS/MSD recovery and precision are outside of QC or advisory limits, an ER shall include the actual recovery/precision values and a brief description of measures taken by the lab in attempting to alleviate the interference.

If specified in Section 6 of the FSP, the MS/MSD shall be spiked at, or below, the analytical level of interest. As applicable to the laboratory's QAP and/or SOPs, the RPD data for each analyte in the matrix spike duplicate (MSD) or laboratory duplicate shall be reported.

A.9.2.2.8 Analytical Duplicate Data (R8)

If an analytical duplicate (i.e., laboratory duplicate) sample was analyzed, the laboratory data package shall include the duplicate sample test report or analysis summary form. The duplicate sample test report or analysis summary form shall include the calculated relative percent difference (RPD) between the sample and the sample duplicate results and the QC limits for the RPD. The test report or summary form shall also include the laboratory batch number and the sample identification number of the parent sample. The laboratory data package shall include an easy means by which the samples associated with that particular duplicate analysis can be identified.

A.9.2.2.9 Method Quantitation Limits and Detectability Check Sample Results (R9)

The laboratory data package shall include the method quantitation limit (MQL) for each chemical of concern specified in Section 3 of the FSP or, when the chemicals of concern are not specified, each analyte included in the laboratory's initial calibration standard mixture(s). The MQL is defined as the concentration of the lowest non-zero standard (adjusted for final volume or weight) in the laboratory's initial calibration curve. See Element B.5.4.7 of this QAPP for requirements related to acceptable concentrations for the MQL.

In addition, the laboratory data package shall include the laboratory's detectability check sample (DCS) results for the analytes included in the laboratory's calibration curve in each matrix for which data are reported. The DCS is a reagent matrix spiked with the chemicals of concern near, or within two to three times, the calculated MDL and carried through the sample preparation procedures for the analysis. The DCS shall be analyzed at a minimum on a quarterly basis to verify the reasonableness of the MDL.

A.9.2.2.10 Other Problems/Anomalies (R10)

The laboratory shall document and report all other problems and/or anomalies observed by the laboratory that might affect the quality of the project data in the LRCs. Corrective actions taken by the laboratory shall be documented, reported to the TCEQ Contractor or the PRP and the project QAS, and the documentation shall be retained by the laboratory with the data generated under this QAPP and shall be readily available for review upon request by TCEQ or the TCEQ Contractor. Corrective actions taken by the laboratory that have the potential to impact the quality of project data will be evaluated and documented in the data usability summary as described in subsection "Corrective Actions and Workplan Deviations" in Element D.2.3.2.

A.9.2.2.11 Validation Results for Non-Reference Methods

If the laboratory uses an analytical method other than those reference methods published by a nationally recognized organization, the laboratory data package shall include all validation data documenting that the non-reference method can produce data of known quality that meet the project objectives for each chemical of concern specified in Section 3 of the FSP. Additionally, the non-reference method shall be included in Section 6 of the FSP. The laboratory's procedures shall be documented in the laboratory's SOPs. If the laboratory cites a reference method, which is published by the TCEQ or a nationally recognized organization, and deviates from that method beyond the modifications allowed in that method, the data generated by that method are considered suspect until the laboratory validates the data against the reference method.

The data package shall include the performance data demonstrating that the modified method meets the QC performance criteria of the reference method. The data package shall include the comparison of the results obtained from the proposed method with those obtained for the approved reference method, interference studies, method and instrument detection limit studies, multiple-level matrix spikes studies of representative sample types, and precision and accuracy determinations, as applicable to the modifications being made. These method modifications shall be documented in Section 6 of the FSP.

A.9.3 Laboratory Performance Criteria (Supporting Data)

The laboratory performance criteria form the basis for the supporting data. These items shall be thoroughly reviewed by the laboratory. The results of that review shall be

documented in the LRCs and associated ERs which are included in the laboratory data package submitted for each project or phase. The laboratory data package shall only contain descriptions of these QC measures if the results fail to meet the control limits specified in the analytical methods, the laboratory QAP and SOPs.

The laboratory performance criteria include the following and are noted with a (S#) for referencing to “supporting data” itemized on the LRC included in Attachment 1:

- Initial calibrations (S1)
- Initial and continuing calibration verifications and continuing calibration blank (S2)
- Mass spectral tuning for analyses (S3)
- Evaluation of internal standard areas (S4)
- Sample preparation/analytical raw data, including sample preparation and run logs and chromatographic and spectral data (S5)
- Dual column confirmation for GC analyses (S6)
- Tentatively Identified Compounds for GC/mass spec analyses (S7)
- Interference check sample results for metal analyses (S8)
- Sample-specific serial dilutions, post digestion spikes, and Method of Standard Additions for metal analyses (S9)
- Method detection limit determinations (S10)
- Proficiency test or performance evaluation study reports (S11)
- Documentation of standards (S12)
- Compound/analyte identification procedures (S13)
- Demonstration of analyst competency (S14)
- Verification/validation documentation for methods (S15)
- Compliance with laboratory standard operating procedures (S16)

These measures are under the control of the laboratory (with the exception of items S7 and S9 in the LRC) and do not depend on the specific nature of the matrix being analyzed and shall be reviewed by the laboratory, including the items in S7 and S9. Any problems identified by the laboratory during that review shall be included in the laboratory data package submitted to the TCEQ as part of the LRC and associated ERs. If a laboratory has in place and implements a quality assurance program that meets the requirements of a recognized organization, such as EPA or NELAP, problems with the data should be random, minimal, appropriately addressed through the laboratory's corrective action procedures, and shall be adequately documented in the LRC.

Laboratory supporting data shall be maintained on file and available for inspection. The laboratory supporting data shall be submitted to the TCEQ within the contractually specified timeframe. The laboratory supporting data is subject to review by TCEQ at any time. A review of the laboratory supporting data by the TCEQ would be warranted if a review of the required reportable data submitted to the TCEQ indicates problems may

exist with the data, and the problems were not identified and resolved by either the laboratory or the person submitting the data, or if the data come under scrutiny for evidentiary reasons. Laboratory supporting data outside of QC acceptance criteria shall be identified in the LRC contained within the original data package submitted to the TCEQ.

The laboratory can store the laboratory supporting data electronically; however, the laboratory supporting data shall be made available to the TCEQ within the contractually specified timeframe. If any of the QC measures described in the laboratory supporting data do not meet QC limits, an ER shall be included in the LRC for the laboratory data package submitted to the TCEQ. The ERs shall include identification of all instances when quality control measure results failed to meet acceptance criteria, and a complete description of the QC measure involved, the acceptance limit, and the value for the QC measure outside of acceptance limits. Descriptions in the ERs shall include the samples affected by the problem(s)/anomalies and the direction and estimated magnitude of the bias, if possible. The turn-around time for the project is specified in Section 3 of the FSP.

A.9.4 CLP or EPA Region 6 Laboratory Data Package

When a CLP laboratory or the EPA Region 6 Laboratory analyzes project samples, the laboratory data package will meet the reporting requirements specified in the applicable EPA CLP Statement of Work (SOW) or by the EPA Region 6 Laboratory, respectively.

A.9.5 Data Handling Records

Data handling records shall document protocols used in data reduction, verification, and validation. Data reduction includes data transformation operations, such as converting raw data into reportable quantities and units, use of significant figures, recording of extreme values, blank corrections, etc. Data verification ensures the accuracy of data transcription and calculations, if necessary, by checking a set of computer calculations manually. Data validation ensures that QC criteria have been met. Procedures for data reduction, verification, and validation are specified in Element D.2.

A.9.6 Data Reporting Package Format and Document Control

The format of laboratory data reporting packages shall be consistent with the requirements in Element A.9.2 above.

A.9.7 Field Records/Data Reporting Package Archiving and Retrieval

The Contractor will archive and maintain all records for a period of 10 years from the date the record was created unless otherwise specified by the TCEQ. The Contractor will make the records available within a reasonable amount of time upon request by the TCEQ. The Contractor shall obtain written consent from the TCEQ before disposing of records at the end of the specified period.

Project data and the associated report submittals are file coded according to either the state or federal Superfund Program file structure, as specified in the standard operating procedure (SOP) *Records*. The TCEQ Central Records maintains the microfilmed site project files and makes these records readily available to program staff and the public. In addition, the records retention schedule is maintained and revised as necessary by the Superfund Program records liaison within the Remediation Division.

B.0 DATA GENERATION AND ACQUISITION

B.1 *Sampling Process Design (Experimental Design)*

All the relevant components of the experimental design; the key parameters to be estimated; the number and type of samples expected; and description of where, when, and how samples are to be taken are included in Section 4 of the FSP. The level of detail in that section shall be sufficient to allow a person knowledgeable of the project to understand how and why the samples will be collected. This section of the FSP should be reviewed by all data users and suppliers to ensure the “right” samples will be collected. Strategies such as stratification, compositing, and clustering shall be discussed, and diagrams or maps showing proposed sampling points shall be included unless specifically omitted with an explanation in Section 6 of the FSP. Most of this information is available as outputs from the final steps of the systematic planning process.

In addition to describing the design, Section 4 of the FSP discusses the following:

- rationale for the design (in terms of meeting the project objectives),
- sampling design assumptions,
- procedures for locating and selecting environmental samples,
- classification of measurements as critical or noncritical,
- type and number of samples required,
- proposed sampling locations and frequency,
- sample matrices, and
- identification of critical samples.

B.2 *Sampling Methods*

The following sampling method requirements are specified in Section 4 of the FSP:

- sampling methods (collection, preparation, homogenization, decontamination);
- verification that the laboratory has adequate sample support procedures for the preparation and analysis methods to meet project objectives;
- identification of persons responsible for corrective action; and
- identification of sampling equipment.

B.2.1 Sample Containers

Sample containers shall generally be purchased pre-cleaned and treated according to EPA specifications for the methods. Sampling containers that are reused are decontaminated between uses by the EPA-recommended procedures (i.e., EPA 540/R-

93/051). Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants.

B.2.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on samples are listed in Table B.2.2-1. The required sample volumes, container types, and preservation requirements for analytical methods proposed for project work not listed in Table B.2.2-1 shall be included in Section 4 of the FSP.

Table B.2.2-1 Sample Containers, Volumes, Preservation, and Holding Times

Name	Analytical Methods*	Container ^a	Minimum Sample Volume or Weight	Preservation ^b	Maximum Holding Time
Alkalinity	E310.1	P, G	50 mL	≤ 6°C	14 days
Common anions	SW9056A	P, G	50 mL	≤ 6°C	28 days for Br ⁻ , F ⁻ , Cl ⁻ and SO ₄ ⁻² ; 48 hours for NO ₃ ⁻ , NO ₂ ⁻ and PO ₄ ⁻³
Perchlorate	E314.1	P,G	50 mL	≤ 6°C	28 days
Cyanide, total and amenable to chlorination	SW9010C SW9012B	P, G	500 mL or 4 ounces	≤ 6°C; NaOH to pH > 12, 0.6 g ascorbic acid	water and soil 14 days
Filterable residue	E160.1	P, G	100 mL	≤ 6°C	7 days
Nonfilterable residue	E160.2	P, G	100 mL	≤ 6°C	7 days
Hydrogen ion (pH), water	SW9040C	P, G	N/A	None required	Analyze immediately ^c
Hydrogen ion (pH), soil and waste	SW9045D	P,G	N/A	None required	Analyze immediately ^c
Conductance	SW9050A	P, G	N/A	≤ 6°C	Analyze immediately ^c
Temperature	E170.1	P, G	N/A	None required	Analyze immediately ^c
Dissolved oxygen	E360.1	G (BOD bottles when possible)	500 mL	None required	Analyze immediately ^c
Turbidity	E180.1	P, G	100 mL	≤ 6°C	48 hours
Total organic carbon	SW9060A	P, G	500 mL or 4 ounces	≤ 6°C, HCl or H ₂ SO ₄ to pH <2	water and soil 28 days
Chromium (VI)	SW7196A SW3060A for soil digestion	P, G	500 mL or 8 ounces	≤ 6°C	water 24 hours; soil 30 days until extraction and 7 days after extraction
Mercury	SW7470A SW7471B	P, G	500 mL or 8 ounces	HNO ₃ pH <2, ≤ 6°C	water and soil 28 days

Name	Analytical Methods*	Container ^a	Minimum Sample Volume or Weight	Preservation ^b	Maximum Holding Time
Metals (except chromium (VI) and mercury)	SW6010D, SW6020B, or SW7010	P, G	500 mL or 8 ounces	Water: HNO ₃ to pH <2	water and soil 180 days
Total petroleum hydrocarbons (TPH) -volatile	TCEQ 1005	G, Teflon-lined septum or lid	3 x tared 40-mL vials	Water: ≤ 6°C, HCl to pH <2 Soil: ≤ 6°C	water and soil 14 days from collection to extraction and 14 days after extraction
Volatile aromatics	SW8021B	G, Teflon-lined septum	Water: 2 x 40-mL vials Soil: 3 x tared 40-mL vials	≤ 6°C, HCl to pH <2; 0.008% Na ₂ S ₂ O ₃ ^d	water is 14 days (7 days if unpreserved by acid); soil is 48 hours (14 days if preserved by lab following TCEQ Method 5035 guidance)
Halogenated volatiles	SW8021B	G, Teflon-lined septum	2x40 mL or 4 ounces	≤ 6°C; no acid preservation; 0.008% Na ₂ S ₂ O ₃ ^d	water is 7 days; soil is 14 days
Nitrosamines	SW8070A	G, Teflon-lined cap	1 liter or 8 ounces	≤ 6°C	water is 7 days until extraction and 40 days after extraction; soil is 14 days until extraction and 40 days after extraction
Chlorinated herbicides	SW8151A	G, Teflon-lined cap	1 liter or 8 ounces	≤ 6°C	water is 7 days until extraction and 40 days after extraction; soil is 14 days until extraction and 40 days after extraction
Organochlorine pesticides	SW8081B	G, Teflon-lined cap	1 liter or 8 ounces	≤ 6°C	water is 7 days until extraction and 40 days after extraction; soil is 14 days until extraction and 40 days after extraction
Polychlorinated biphenyls (PCBs)	SW8082A	G, Teflon-lined cap	1 liter or 8 ounces	≤ 6°C	None from collection to extraction. Analyze within 40 days from extraction
Organo-phosphorus pesticides and compounds	SW8141B	G, Teflon-lined cap	1 liter or 8 ounces	≤ 6°C	water is 7 days until extraction and 40 days after extraction; soil is 14 days until extraction and 40 days after extraction
Semivolatile organics	SW8270D	G, Teflon-lined cap	1 liter or 8 ounces	≤ 6°C, 0.008% Na ₂ S ₂ O ₃ ^d	water is 7 days until extraction and 40 days after extraction; soil is 14 days until extraction and 40 days after extraction
Volatile organics	SW8260C	G, Teflon-lined septum	Water: 2 x 40-mL vials Soil: 3 x tared 40-mL vials	Water: ≤ 6°C, HCl to pH <2 Soil: ≤ 6°C	water is 14 days (7 days if unpreserved by acid); soil is 48 hours (14 days if preserved by lab following TCEQ Method 5035 guidance)
Polynuclear aromatic hydrocarbons (PAHs)	SW8310	G, Teflon-lined cap	1 liter or 8 ounces	≤ 6°C, store in dark, 0.008% Na ₂ S ₂ O ₃ ^d	water is 7 days until extraction and 40 days after extraction; soil is 14 days until extraction and 40 days after extraction
Dioxins and furans	SW8280B, SW8290A	G, Teflon-lined cap	1 liter or 8 ounces	≤ 6°C, 0.008% Na ₂ S ₂ O ₃ ^d (kept dark)	For water and soil is 30 days until extraction and 45 days after extraction

Name	Analytical Methods*	Container ^a	Minimum Sample Volume or Weight	Preservation ^b	Maximum Holding Time
Ethylene dibromide (EDB)	SW8011	G, Teflon-lined cap	Water: 2 x 40-mL vials Soil: 3 x tared 40-mL vials	Water: $\leq 6^{\circ}\text{C}$, HCl to pH <2 $\leq 6^{\circ}\text{C}$, 0.008% $\text{Na}_2\text{S}_2\text{O}_3^{\text{d}}$ Soil: $\leq 6^{\circ}\text{C}$	water is 14 days (7 days if unpreserved by acid); soil is 48 hours (14 days if preserved by lab following TCEQ Method 5035 guidance)
Explosive residues	SW8330B	P, G	1 liter or 8 ounces	$\leq 6^{\circ}\text{C}$	water is 7 days until extraction and 40 days after extraction; soil is 14 days until extraction and 40 days after extraction
TCLP	SW1311	G, Teflon-lined cap	1 liter or 8 ounces	$\leq 6^{\circ}\text{C}$	volatiles is 14 days to TCLP extraction and 14 days after extraction; semivolatiles 14 days to TCLP extraction, 7 days to prep extraction and 40 days after prep extraction; mercury is 28 days to TCLP extraction and 28 days after extraction; metals is 180 days to TCLP extraction and 180 days after extraction
SPLP	SW1312	G, Teflon-lined cap	1 liter or 8 ounces	$\leq 6^{\circ}\text{C}$	volatiles is 14 days to SPLP extraction and 14 days after extraction; semivolatiles is 14 days to SPLP extraction, 7 days to prep extraction and 40 days after prep extraction; mercury is 28 days to SPLP extraction and 28 days after extraction; metals is 180 days to SPLP extraction and 180 days after extraction
Volatile Organics	TO-15	SUMMA [®] canister	NA	None	30 days to analysis

- a. P is Polyethylene; G is glass
b. No pH adjustment for soil. Aqueous samples shall not be frozen.
c. Measurement should be performed on site.
d. Preservation with 0.008 percent $\text{Na}_2\text{S}_2\text{O}_3$ is only required when residual chlorine is present.
* E is EPA Methods for Chemical Analysis of Water and Wastes; SW is SW846

B.3 Sample Handling and Custody

B.3.1 Field Sample Handling and Custody

Sample handling and custody requirements prior to samples being received at the analytical laboratory are contained in Section 4 of the FSP. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times are specified in Table B.2.2-1. If the holding time for a sample is specified in hours up to 48 hours, the time (i.e., hours and minutes) and the date of collection shall be included on the sample label and field custody document. At TCEQ discretion, samples not preserved or not analyzed in accordance with the requirements in Table B.2.2-1 shall be recollected and analyzed, at no additional cost to the TCEQ.

B.3.2 Laboratory Sample Handling and Custody

The laboratory QAP and associated laboratory SOPs shall specify the laboratory sample handling and custody requirements to be followed. These requirements shall be generally consistent with NELAP. In addition, the following procedures shall be adhered to:

Once the samples reach the laboratory, the laboratory sample custodian shall verify each cooler containing samples is sealed with an intact custody seal and tape. The receiving laboratory shall reject any sample cooler that shows evidence of tampering with the custody seal and tape. In addition, the samples shall be checked for anomalies against information on the custody form contained in each cooler. The condition, temperature, and appropriate preservation of samples shall be checked and documented on the custody form. Appropriate methods for measuring the temperature of samples in the cooler include measuring the temperature of a temperature blank contained in the cooler or using an infrared temperature measurement device to measure the temperature in an unopened aqueous sample. If ice is found to be present in the cooler upon receipt, the laboratory shall also note this on the custody form and may consider this an adequate indication that the cooler temperature is not above the acceptance criterion of $\leq 6^{\circ}\text{C}$. Checking an aliquot of the sample using pH paper is an acceptable procedure for checking acid/base preservation, except for sample containers to be used for volatile organic compound (VOC) analysis. The check of pH in samples for VOC analysis is performed on an additional sample to check preservation. The occurrence of any anomalies in the received samples and the resolution of these anomalies shall be documented in laboratory records and the Exception Reports submitted with the LRC. All sample information shall be entered into a tracking system, and unique laboratory analytical sample identifiers shall be assigned. A copy of this information shall be reviewed by the laboratory for accuracy.

Procedures ensuring internal laboratory custody shall also be implemented and documented by the laboratory. Specific instructions concerning the analysis specified for each sample shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

While in the laboratory, samples shall be stored in limited-access, temperature-controlled areas and refrigerators, coolers, and freezers shall be monitored for temperature daily. The acceptance criterion for the temperatures of the refrigerators and coolers is 0.1 to 6°C. Acceptance criteria for the temperatures of the freezers shall be between -7°C and -20°C. All of the cold storage areas shall be monitored by thermometers or other temperature monitoring devices that have been calibrated against a NIST-traceable thermometer. As indicated by the findings of the calibration, correction factors shall be applied to each thermometer. Records that include acceptance criteria shall be maintained. All samples shall be stored separately from standards. Samples for volatile organics determination shall be stored separately from other samples, standards, and sample extracts. Samples shall be stored after analysis until disposed of in accordance with applicable local, state, and federal regulations. Prior to disposal the laboratory shall contact the Contractor. Disposal records shall be maintained by the laboratory.

B.4 Analytical Methods

Analytical methods covered by this QAPP are split into two types of methods: screening methods and definitive methods. The screening methods are generally designed for use in the field, although several laboratory methods are also classified as screening methods based on the generally lower level of required QC analyses. Methods considered routine screening methods and definitive preparation and analysis methods are described in Element B.4 and B.5, respectively. Section 6 of the FSP includes alternative or additional standard analytical methods to be used based on project requirements. The specific analytical methods to be used are listed, including specific options within a method to be used, when such options exist.

The Contactor or TCEQ PM will use Section 6 of the FSP to identify nonstandard sampling methods, sample matrices, or other unusual situations that will be used or encountered during the project and to specify the type of validation study data needed for the project. The appropriate method validation study information shall be provided to confirm the performance of the method for the particular matrix and to assess the potential impact on the representativeness of the data generated. Non-standard analytical methods, both modified published methods and unpublished methods used to generate quantitative data, require validation by the laboratory unless specified otherwise in Section 6 of the FSP. Qualitative data from a modified method will not require rigorous validation unless otherwise specified in Section 6 of the FSP. Available validation studies for the non-standard methods, including round-robin studies

performed by EPA or by other organizations, shall be referenced in Section 6 of the FSP. If previous validation studies are not available, the level of single-user validation study or ruggedness study shall be specified in Section 6 of the FSP and shall be performed during the project and included as part of the project's final report.

B.4.1 Screening Methods

Table B.4.1-1 in the QAPP provides a listing of commonly used screening methods. These methods and QC procedures were taken from Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA SW-846, Third Edition, and its updates) noted as “SW”, Methods for Chemical Analysis of Water and Waste (EPA 600) noted as “E”, American Society of Testing Materials Annual Book of Standards (1993) noted as “ASTM”, and from manufacturers’ literature. A brief description of each of the methods included in the table is provided below in this element.

Table B.4.1-1 Screening Analytical Methods

Method	Parameter
SW846 (Section 7.2 of SW3550)	Moisture
SW1020B	Ignitability (for liquids)
SW1030	Ignitability (for solids)
SW1110A	Corrosivity
SW9040C	pH (water)
SW9045D	pH (soil and waste)
SW9050A	Specific Conductance
D6317-98	Total Carbon
D6317-98	Total Inorganic Carbon
SW9060A	Total Organic Carbon
E160.1	Filterable Residue
E160.2	Nonfilterable Residue
E170.1	Temperature
E180.1	Turbidity
E310.1	Alkalinity
E360.1	Dissolved oxygen
SW9071B	Oil and Grease
ASTM D422	Particle size
ASTM D1498	Oxidation-reduction potential
SW4020	PCBs by Immunoassay
SW4030	TPH by Immunoassay
SW4035	PAHs by Immunoassay
SW6200	26 metals by Field Portable X-Ray Fluorescence Spectrometry (soil and sediments)
Field Test Kit Method	Ferrous Iron

B.4.1.1 *SW-846 (Described in Method SW3550, Section 7.2)–
Percent Moisture*

Percent moisture is determined for solid samples undergoing analysis for inorganic and organic analytes. The sample is weighed, dried, and then reweighed. Percent moisture is calculated as:

$$\% \text{ Moisture} = \frac{\text{Initial Weight} - \text{Dried Weight}}{\text{Initial Weight}} \times 100$$

The moisture content is used to calculate results for soil samples on a dry weight basis using the calculation presented below:

$$\text{Results of analysis on dry weight bases} = \frac{\text{Result of analysis on wet weight basis}}{1 - (\% \text{ moisture} / 100)}$$

All soil or sediment results and SDLs shall be reported on a dry weight basis.

B.4.1.2 *EPA Method SW1020B–Ignitability*

Method 1020A makes use of the Setaflash Closed Tester to determine the flash point of liquids that have flash points between 0°C and 110°C and viscosities lower than 150 stokes at 25°C.

B.4.1.3 *EPA Method SW1030–Ignitability of Solids*

In a preliminary test, the test material is formed into an unbroken strip or powder train 250 mm in length. An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within a specified time period. Materials that propagate burning along a 200 mm strip within the specified time period are then subjected to a burning rate test. Materials that do not ignite or propagate combustion as described above do not require further testing. In the burning rate test, the burning time is measured over a distance of 100 mm and the rate of burning is determined.

B.4.1.4 *EPA Method SW1110A–Corrosivity*

This test exposes steel to liquid waste to determine the corrosivity of the waste.

B.4.1.5 *EPA Method SW9040C (water)/SW9045D (soil and waste)–pH*

Measurements of pH shall be performed for water samples using Method SW9040C. pH measurements of soil and waste samples are performed using Method SW9045D. Measurements are determined electrometrically using either a glass electrode in combination with a reference potential, or a combination electrode.

B.4.1.6 *EPA Method SW9050A–Specific Conductance*

Standard conductivity meters are used. Temperature is also reported. Results are corrected to 25°C.

B.4.1.7 *ASTM Method D6317-98 –Total Carbon and Total Inorganic Carbon*

This test method covers the determination of total carbon (TC), inorganic carbon (IC), and total organic carbon (TOC) in water in the range from 10 to 1000 µg/L of carbon. This method is for laboratory or grab sample applications. The test method utilizes persulfate or ultraviolet oxidation of organic carbon, or both, coupled with a CO₂ selective membrane to recover the CO₂ into deionized water. The change in conductivity of the deionized water is measured and related to carbon concentration in the oxidized sample. Inorganic carbon is determined in a similar manner without the oxidation step. In both cases, the sample is acidified to facilitate CO₂ recovery through the membrane. The relationship between the conductivity measurement and the carbon concentration is described by a set of stoichiometric equations for the chemical equilibrium of CO₂, HCO₃⁻, and H⁺, and the relationship between the ionic concentrations and the conductances resulting in linear response of the method over the stated range of TOC.

B.4.1.8 *EPA Method SW9060A–Total Organic Carbon*

Organic carbon is measured using a carbonaceous analyzer. This instrument converts the organic carbon in a sample to carbon dioxide (CO₂) by either catalytic combustion or wet chemical oxidation. The CO₂ formed is then either measured directly by an infrared detector or converted to methane (CH₄) and measured by a flame ionization detector. The amount of CO₂ or CH₄ in a sample is directly proportional to the concentration of carbonaceous material in the sample.

B.4.1.9 *EPA Method 160.1–Filterable Residue*

A well-mixed sample is filtered through a standard glass fiber filter. The filtrate is evaporated and dried to constant weight at 180°C. If non-filterable residue is being determined, the filtrate from that method may be used for the filterable residue determination.

B.4.1.10 *EPA Method 160.2–Nonfilterable Residue*

A well-mixed sample is filtered through a glass fiber filter, and the residue retained on the filter is dried to constant weight at 103-105°C. The filtrate from this method may be used to determine the filterable residue.

B.4.1.11 *EPA Method 170.1–Temperature*

Temperature measurements are made with a mercury-filled or dial type centigrade thermometer, or a thermistor.

B.4.1.12 *EPA Method 180.1–Turbidity*

This method is based on a comparison of the light scattered by the sample under defined conditions with the light intensity scattered by a standard reference suspension. The principle is the higher the intensity, the greater the turbidity. Turbidity measurements are made in a nephelometer and are reported in terms of nephelometric turbidity units (NTUs). The working range for the method is from 0–40 NTU. Higher levels of turbidity can be measured by diluting the sample with turbidity-free deionized water.

B.4.1.13 *EPA Method 310.1–Alkalinity*

In this method, an unaltered sample is titrated to an end point of pH 4.5 using hydrochloric or sulfuric acid.

B.4.1.14 *EPA Method 360.1–Dissolved Oxygen*

An instrumental probe, usually dependent upon an electrochemical reaction, is used for determination of dissolved oxygen in water. Under steady-state conditions, the current or potential can be correlated with dissolved oxygen concentrations.

B.4.1.15 *SW9071B–n-Hexane Extractable Material (HEM) for Sludge, Sediment and Solid Samples*

This method involves the gravimetric determination of n-hexane extractable material (HEM) by Soxhlet extraction with n-hexane. “HEM” may be considered synonymous with “oil and grease” within the limitations discussed in the method.

B.4.1.16 *ASTM D422–Standard Method for Particle-Size Analysis of Soils*

This method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than 75 µm (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 µm is determined by a sedimentation process using a hydrometer.

B.4.1.17 *ASTM D1498-93–Oxidation-Reduction Potential*

This method is designed to measure the oxidation-reduction potential (ORP) in water, which is defined as the electromotive force between a noble metal electrode and a reference electrode when immersed in a solution.

B.4.1.18 *Method SW4020–Screening for Polychlorinated Biphenyls by Immunoassay*

Soil samples are screened for total polychlorinated biphenyls (PCBs) using immunoassay test kits. A mini methanol extraction of the soil sample is performed, and the extract and an enzyme conjugate reagent are added to immobilized antibodies. The enzyme conjugate competes with the PCBs in the sample for binding to immobilized anti-PCB antibodies. The test is interpreted by comparing the response produced by the sample to the response produced by a standard.

B.4.1.19 *Method SW4030–Screening for Petroleum Hydrocarbons by Immunoassay*

Soil samples are screened for levels of total petroleum hydrocarbons (TPH) using TPH test kits. A mini extraction of the soil sample is performed, and the extract and an enzyme conjugate reagent are added to immobilized antibodies. The enzyme conjugate competes with hydrocarbons for binding to immobilized anti-hydrocarbon antibodies. The test is interpreted by comparing the response produced by the sample to the response produced by a standard.

B.4.1.20 *Method SW4035–Screening for Polynuclear Aromatic Hydrocarbons by Immunoassay*

Soil samples are screened for levels of total polynuclear aromatic hydrocarbons (PAHs) using PAH test kits. A mini extraction of the soil sample is performed, and the extract and an enzyme conjugate reagent are added to immobilized antibodies. The enzyme conjugate competes with PAHs present in the sample for binding to immobilized anti-PAH antibodies. The test is interpreted by comparing the response produced by the sample to the response produced by a standard.

B.4.1.21 *Method SW6200–Screening for Field Portable X-ray Fluorescence*

Soil and sediment samples are screened for up to 26 metals using *in situ* or *ex situ* analysis by field portable X-ray fluorescence (FPXRF) spectrometry. Confirmation analyses will be performed as specified in the FSP using other techniques, such as flame atomic absorption spectrometry (FLAA), graphite furnace atomic absorption spectrometry (GFAA), inductively coupled plasma-atomic emission spectrometry (ICP-AES), or inductively coupled plasma-mass spectrometry (ICP-MS). Generally, elements

of atomic number 16 or greater can be detected and quantified by FPXRF. During the project planning activities, the quality of data generated by this method for each metal of concern will be evaluated against the project objectives to determine if the FPXRF can be used during the project and to determine the project-specific type and frequency of QC parameters.

B.4.1.22 *Ferrous Iron*

Aqueous samples are screened for ferrous iron concentrations using field test kits. The analytical method utilizes a field-portable colorimeter measurement on an unfiltered water sample.

B.4.2 Definitive Preparation Methods

Below in this element is a brief description of some common preparation methods. Element B.4.3 contains brief descriptions for some common analytical procedures, and Element B.5 includes associated quality control criteria and procedures.

The information in these elements was obtained from the Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA SW-846, Third Edition, and its updates);

Any project-specific extraction and digestion procedures for liquid and solid matrices shall be included in Section 6 of the FSP. Commonly used extraction and digestion procedures for liquid and solid matrices are presented in Table B.4.2-1 in this element. The preparation methods which are applicable for each analytical method are present in Table B.4.3-1 in this element.

Table B.4.2-1 Extraction and Digestion Procedures

Method*	Parameter
SW1311	Toxicity Characteristic Leaching Procedure
SW1312	Synthetic Precipitation Leaching Procedure
SW3005A	Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy
SW3010A	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy
SW3015A	Microwave Assisted Acid Digestion of Aqueous Samples and Extracts
SW3020A	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by GFAA Spectroscopy
SW3050B	Acid Digestion of Sediments, Sludges and Soils
SW3051A	Microwave Assisted Acid Digestion of Sediments, Sludges, Soils and Oils
SW3060A	Alkaline Digestion of Soils, Sediments, Sludges and Industrial Wastes for Hexavalent Chromium
SW3510C	Separatory Funnel Liquid-Liquid Extraction
SW3511	Organic Compounds in Water by Microextraction
SW3520C	Continuous Liquid-Liquid Extraction
SW3540C/SW3541	Soxhlet Extraction/Automated Soxhlet Extraction
SW3550C	Ultrasonic Extraction
SW5030C	Purge and Trap (aqueous samples)
TCEQ SOP for SW5035	Purge and Trap (sediment, sludge, and soil samples)

* SW denotes a method found in SW-846 (Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, EPA SW-846, Third Edition, and its updates).

B.4.2.1 *Method SW1311–Toxicity Characteristic Leaching Procedure*

Method SW1311 is used to prepare samples for determining whether a waste or other material which is being classified for land disposal is considered a characteristic hazardous waste due to leachability of organic and inorganic constituents. The TCLP is also used for initial waste determinations to determine if a waste is hazardous for the characteristic of toxicity.

The QC is accomplished by preparing a toxicity characteristic leaching procedure (TCLP) blank at a rate of one blank for every 20 extractions conducted in the extraction vessel. Additional extract is prepared so one MS is performed for each waste type (samples of similar waste types shall be batched together). One MS must be analyzed in each project analytical batch. These QA measures are in accordance with the requirements of EPA Method SW1311, Section 8.0.

B.4.2.2 *Method SW1312–Synthetic Precipitation Leaching Procedure*

This method is used to prepare samples for determining the mobility of organic and inorganic constituents in liquids, soils, and wastes which are to be left in place at a site.

QC is accomplished by preparing a synthetic precipitation leaching procedure (SPLP) blank at the rate of one blank for every 20 extractions conducted in the extraction vessel. A matrix spike is performed on an extract from each waste type (samples of similar waste types shall be batched together). One MS must be analyzed in each project analytical batch. The use of internal calibration quantitation methods shall be used for metallic contaminants if: 1) the recovery of the contaminant from the SPLP extract is below 50%; and 2) the concentration of the contaminant is below but within 20% of the regulatory level. These QA measures are in accordance with the requirements of EPA SW1312, Section 8.0.

B.4.2.3 *Method SW3005A–Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy*

This method is an acid digestion procedure used to prepare water samples for metals analysis. The digested samples are analyzed for total recoverable and dissolved metals determination by either flame atomic absorption (FLAA) or inductively coupled plasma (ICP).

For analysis of total recoverable metals, the entire sample is acidified at collection time. For dissolved metals, the sample is filtered and filtrate is then acidified. An unfiltered sample analysis shall generally be required for groundwater samples.

B.4.2.4 *Method SW3010A—Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy*

Method SW3010A prepares aqueous or waste samples for total metals determination by FLAA or ICP. The samples are vigorously digested with acid and then diluted.

B.4.2.5 *Method SW3015A—Microwave Assisted Acid Digestion of Aqueous Samples and Extracts*

This method is used to prepare aqueous or waste samples, that contain suspended solids, for total metals determination by graphite furnace atomic absorption spectroscopy (GFAA), FLAA or ICP. The samples are digested with acid and heated in a microwave.

B.4.2.6 *Method SW3020A—Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by GFAA Spectroscopy*

Method SW3020A prepares aqueous or waste samples for total metals determination by GFAA or ICP. The samples are vigorously digested with acid and then diluted.

B.4.2.7 *Method SW3050B—Acid Digestion of Sediments, Sludges, and Soils*

Method SW3050B contains two digestion procedures. One is applicable to the preparation of sediment, sludge, and soil samples for metals analysis by FLAA or ICP. The other is applicable to the preparation of sediment, sludge, and soil samples for metals analysis by GFAA or ICP-mass spectrometry (mass spec). A sample is repeatedly treated with nitric acid and hydrogen peroxide. For analyses by FLAA or ICP, the digestate is also treated with hydrochloric acid. If antimony, barium, lead, or silver are analyzed by FLAA or ICP, the optional procedure given in Section 7.5 of Method SW3050B must be used to improve the solubilities and recoveries of these metals. A separate aliquot of the sample is dried for a total solids and/or percent moisture determination.

B.4.2.8 *Method SW3051A—Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, and Oils*

Method SW3051A is applicable to the preparation of sediment, sludge, and soil samples for metals analysis by FLAA, GFAA, or ICP. The samples are digested with acid and heated in a microwave. A separate aliquot of the sample is dried for a total solids and/or percent moisture determination.

B.4.2.9 *Method SW3060A—Alkaline Digestion of Soils, Sediments, Sludges, and Industrial Wastes for Hexavalent Chromium*

This method uses an alkaline digestion to solubilize both water-insoluble (with the exception of partial solubility of barium chromate in some soil matrices) and water soluble hexavalent chromium compounds in solid waste samples. This is the only acceptable digestion procedure to prepare soil or sediment samples for hexavalent chromium analysis.

B.4.2.10 *Method SW3510C—Separatory Funnel Liquid-Liquid Extraction*

Method SW3510C is designed to quantitatively extract nonvolatile and semivolatile organic compounds from liquid samples using standard separatory funnel techniques. The sample and the extracting solvent must be immiscible in order to yield recovery of target compounds. Subsequent cleanup and detection methods are described in the organic analytical method used to analyze the extract.

B.4.2.11 *Method SW3511 - Organic Compounds in Water by Microextraction*

Method 3511 is a procedure for extracting selected volatile and semivolatile organic compounds from water using a microscale approach which minimizes sample size and solvent usage, thereby reducing the supply costs, health and safety issues, and waste generated.

B.4.2.12 *Method SW3520C—Continuous Liquid-Liquid Extraction*

Method SW3520C is a procedure for isolating nonvolatile and semivolatile organic compounds from aqueous samples and is designed for extraction solvents with greater density than the sample.

B.4.2.13 *Method SW3540C/SW3541—Soxhlet Extraction/Automated Soxhlet Extraction*

Method SW3540C is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils and sludges. Method SW3541 is an automated Soxhlet extraction. The Soxhlet extraction process ensures intimate contact of the sample matrix with the extraction solvent.

B.4.2.14 *Method SW3550C—Ultrasonic Extraction*

Method SW3550C is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils and sludges. The sonication process ensures intimate contact of the sample matrix with the extraction solvent.

B.4.2.15 *Method SW5030C—Purge and Trap Method for Aqueous Samples*

Method SW5030C describes sample preparation and extraction for the analysis of VOCs. The method is applicable to aqueous and water miscible liquid samples. The success of this method depends on the level of interferences in the sample.

An inert gas is bubbled through the sample solution at ambient temperature to transfer the volatile components to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a GC column.

B.4.2.16 *Method SW5035A—Closed-System Purge and Trap and Extraction for Volatile Organics in Soil and Waste Samples*

This method describes a closed-system purge-and-trap process for the analysis of VOCs in solid materials (e.g., soils, sediments, and solid waste). While the method is designed for use on samples containing low levels of VOCs, procedures are also provided for collecting and preparing solid samples containing high concentrations of VOCs and for oily wastes. For these high concentration and oily materials, sample collection and preparation are performed using the procedures described here, and sample introduction is performed using the aqueous purge-and-trap procedure given in Method SW5030C. These procedures may be used in conjunction with any appropriate determinative gas chromatographic procedure, including, but not limited to, Methods SW8015, SW8021B, and SW8260C.

B.4.3 Definitive Analysis Methods

Some common analytical procedures are listed in Table B.4.3-1, with associated quality assurance measures and quality control limits that can be used as default criteria during implementation of these methods described in Element B.5 of this QAPP. Use of other analytical methods not included in this element is specified in Section 6 of the FSP. All associated method QC criteria for these methods are presented in Section 6 of the FSP to the same level of detail as presented in this Element B. If the FSP does not specify the project-specific analytes, the laboratory will report in the laboratory data package the results for all analytes included on the analyte list as specified for each method below and will release the data package(s) to Contractor and/or the TCEQ PM.

Table B.4.3-1 Definitive Analytical Procedures

Analytical Method*	Parameter	Preparatory Methods
SW8011	Ethylene dibromide (EDB) (water)	8011, 5030C, 5035A
TCEQ 1005	TPH volatile and extractable (water and soil)	NA
SW8021B	Halogenated volatile organics (water and soil)	5030C, 5035A
SW8070A	Nitrosamines (water and soil)	3510C, 3520C, 3540C, 3541, 3550C
SW8081B	Organochlorine pesticides and PCBs (water and soil)	3510C, 3520C, 3540C, 3541, 3550C
SW8082A	Polychlorinated Biphenyls (water and soil)	3510C, 3520C, 3540C, 3541, 3550C
SW8141B	Organophosphorus compounds (water and soil)	3510C, 3520C, 3540C, 3541, 3550C
SW8151A	Chlorinated herbicides (water and soil)	3510C, 3520C, 3540C, 3541, 3550C
SW8260C	Volatile organics (water and soil)	5030C, 5035A
SW8270D	Semivolatile organics (water and soil)	3510C, 3520C, 3540C, 3541, 3550C
SW8280B SW8290	Dioxins and furans (water and soil)	(see analytical method)
SW8310	Polynuclear aromatic hydrocarbons (PAHs) (water and soil)	3510C, 3520C, 3540C, 3541, 3550C
SW8330B	Explosive residues (water and soil)	3510C, 3520C, 3540C, 3541, 3550C
SW6010D	Trace metals by ICP OES (water and soil)	3005A, 3010A, 3015A, 3050B, 3051A
SW6020B	Trace metals by ICP-MS (water and soil)	3005A, 3010A, 3015A, 3050B, 3051A
SW7010	Trace metals by GFAA (water and soil)	3015A, 3020A, 3050B, 3051A
SW7196A	Hexavalent chromium	3060A
SW7470A	Mercury (water)	(see analytical method)
SW7471B	Mercury (soil)	(see analytical method)
SW9010C SW9012B	Cyanide (water)	(see analytical method)
SW9056A	Common anions	N/A
TO-15	Volatile Organics in Ambient Air	N/A

* SW denotes a method found in SW-846 (Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, EPA SW-846, Third Edition, and its updates).

NA Not applicable

B.4.4 Non-standard Method Validation

The specifications for non-standard method validation are described in Element A.9.2.2.11 above and included in Section 6 of the FSP.

B.5 Quality Control

Quality control measures and criteria for some common methods are included in this element below. The QC criteria specified are for laboratory analysis and review and are not intended for use during independent data review and validation. The QC criteria to be used during data review are described in detail in Element D. Element B.5 contains default QC limits to be used by the laboratory for evaluating analyses relative to the contract and method requirements. Any person conducting analyses under this QAPP shall determine, during implementation of the systematic planning process for each project, whether the default QC limits are sufficient to meet the individual project objectives.

B.5.1 Definitive Analytical Methods

Element B.5.1 contains sub-elements for some commonly used analytical procedures. A brief description and tables for each method are included in the sub-elements. The tables present the MQLs for each analyte in the method, the MQLs for both soil and water matrices, the default acceptance criteria for the accuracy and precision of spiked recoveries, and the calibration and QC procedures for each method. If laboratory control limits based on historic data are more stringent than those contained in these tables, the laboratory control limits shall be used.

The information in the tables for each method was generally obtained from the Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA SW-846, Third Edition, and its updates) and HQ Air Force Center for Environmental Excellence Quality Assurance Project Plan, v3.1, August 2001.

B.5.1.1 *Method SW8011-Ethylene Dibromide*

Ethylene dibromide (EDB) in water is analyzed using Method SW8011. The sample is extracted with hexane. The extract is injected into a GC with a linearized electron capture detector for separation and analysis.

This method provides for the use of a second GC column of dissimilar phase to resolve compounds of interest from interferences that may occur. When second-column analysis is performed, retention times for the analyte must match those established for each column. Otherwise, the chromatographic peaks are considered interferences, and the analyte is not considered to be present in the sample.

Table B.5.1.1-1 Method SW8011 MQLs

Analyte, CAS No.	Water MQL	Water Unit
Ethylene dibromide, 106-93-4	0.02	µg/L
1,2,3-Trichloropropane, 96-18-4	0.02	µg/L

Table B.5.1.1-2 Method SW8011 QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)
Ethylene dibromide	80-120	≤ 20
1,2,3-Trichloropropane	80-120	≤ 20
Surrogate: 1,2-Dibromopropane or 1,2-Dichloropropane	70-120	

Table B.5.1.1-3 Method SW8011 Calibration and QC Procedures for Ethylene Dibromide

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	linear – RSD for all analytes $\leq 20\%$ linear – least squares regression $r > 0.995$. non-linear – COD ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	± 3 times standard deviation for each average analyte retention time from 72-hour study or 0.03 minutes, whichever is greater.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration blank.	Once per initial daily multipoint calibration.	No analyte detected $\geq \text{MQL}$.	Correct problem then reanalyze calibration blank and all samples associated with blank.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.1-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected $\geq \text{MQL}$.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.1-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.1-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.1-2.	Describe in LRC.
Second-column confirmation.	100% for all positive results.	Same as for initial or primary column analysis. RPD for the dual column results $\leq 40\%$.	Describe in LRC. If no chromatographic anomalies or problems noted, report the lower result as per Section 11.10.4.2 of Method 8000C.
MDL study.	Once per 12 month period.	Detection limits established shall be $\frac{1}{2}$ the MQLs in Table B.5.1.1-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with TCEQ project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.2 *TCEQ 1005-Volatile and Extractable Total Petroleum Hydrocarbons*

Method 1005 has been designed by the Petroleum Storage Tank Program of the TCEQ as a replacement for EPA Method 418.1 to determine the concentration of total petroleum hydrocarbons (TPH) in soil and groundwater. Method 1005 is a gas chromatographic method which uses flame ionization as the method of detection. The method reports the concentration of hydrocarbons in the following boiling point ranges for each sample: nC6 - nC12, >nC12 - nC28, and nC6 - nC28. When applicable to the project objectives, the >nC28 - nC35 and the nC6 - nC35 ranges shall be reported. These boiling point ranges cover the aromatic hydrocarbons (benzene, toluene, ethylbenzene, and xylene (BTEX)) and polycyclic aromatic hydrocarbons (PAHs) typically of concern in petroleum fuels.

This method should be used by, or under the supervision of, analysts experienced in the use of solvent extraction and gas chromatography. The analysts should also be skilled in the interpretation of capillary gas chromatography data (specifically petroleum hydrocarbon pattern recognition), quantitation using computerized data acquisition, and use of peak processing software with baseline and peak grouping functions.

Second column confirmation is not required.

Table B.5.1.2-1 Method TCEQ 1005 MQLs

Analyte	Water MQL	Water Unit	Soil MQL	Soil Unit
Total Petroleum Hydrocarbons (TPH)	5	mg/L	50	mg/kg

Table B.5.1.2-2 Method TCEQ 1005 QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
TPH	70-130	≤ 30	70-130	≤ 50

Table B.5.1.2-3 Method TCEQ 1005 Calibration and QC Procedures for Total Petroleum Hydrocarbons

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Minimum five-point initial calibration.	Initial calibration prior to sample analysis.	Mean RSD for TPH $\leq 25\%$ or correlation coefficient for linear regression ≥ 0.995 .	Correct problem then repeat initial calibration.
Calibration verification.	Daily, before sample analysis.	RPD $\leq 25\%$ of expected value.	Correct problem then repeat initial calibration.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Initially prior to analysis of any samples and in response to changes in staff, instrumentation, or operations.	QC acceptance criteria, Section 8.2 of analytical method.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No TPH detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.2-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.2-2.	Describe in LRC.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.2-2.	Reanalyze, or reextract and reanalyze all affected samples.
Retention time window check.	Once per analytical batch.	Per Section 7.2.2 of the analytical method.	Correct problem then reanalyze all samples analyzed since the last retention time check.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.2-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.3 *Method SW8021B- Aromatic and Halogenated Volatile Organics*

Aromatic and halogenated volatile organics in water and soil samples are analyzed using Method SW8021B. This method is a purge and trap GC method using preparation Method SW5030C or SW5035A. A temperature program is used in the GC to separate the compounds. Detection is achieved by a PID and an electrolytic conductivity detector (ECD) in series.

For analytes detected by both detectors, no further confirmation need be performed. For analytes detected by only one detector, confirmation on another column is required.

Table B.5.1.3-1 Method SW8021B MQLs for Aromatic and Halogenated Volatile Organics

Analyte	CASRN	Water MQL (ug/L)	Soil MQL (mg/kg)
1,1,1,2-Tetrachloroethane	630-20-6	0.50	0.01
1,1,1-Trichloroethane	71-55-6	1.0	0.01
1,1,2,2-Tetrachloroethane	79-34-5	0.50	0.01
1,1,2-Trichloroethane	79-00-5	0.50	0.01
1,1-Dichloroethane	75-34-3	1.0	0.01
1,1-Dichloroethene	75-35-4	1.0	0.01
1,1-Dichloropropene	563-58-6	1.0	0.01
1,2,3-Trichlorobenzene	, 87-61-6	1.0	0.01
1,2,3-Trichloropropane	96-18-4	4.0	0.01
1,2,4-Trichlorobenzene	120-82-1	1.0	0.01
1,2,4-Trimethylbenzene	95-63-6	1.0	0.01
1,2-Dibromo-3-chloropropane	96-12-8	30.0	0.03
1,2-Dibromoethane	106-93-4	8.0	0.02
1,2-Dichloroethane	107-06-2	0.30	0.01
1,2-Dichlorobenzene	95-50-1	1.0	0.01
1,2-Dichloropropane	78-87-5	1.0	0.01
1,3,5-Trimethylbenzene,	108-67-8	1.0	0.01
1,3-Dichlorobenzene	541-73-1	1.00	0.01
1,3-Dichloropropane	142-28-9	0.30	0.01
1,4-Dichlorobenzene	106-46-7	0.50	0.01
2,2-Dichloropropane	594-20-7	1.0	0.01
2-Chlorotoluene	95-49-8	1.0	0.01
4-Chlorotoluene	106-43-4	1.0	0.01
Benzene	71-43-2	0.20	0.01
Bromobenzene	108-86-1	1.0	0.01
Bromochloromethane	74-97-5	1.0	0.01
Bromodichloromethane	75-27-4	0.20	0.01

Analyte	CASRN	Water MQL (ug/L)	Soil MQL (mg/kg)
Bromoform	75-25-2	1.0	0.01
Bromomethane	74-83-9	5.0	0.01
Carbon Tetrachloride	56-23-5	0.10	0.01
Chlorobenzene	108-90-7	0.50	0.01
Chloroethane	75-00-3	1.0	0.01
Chloroform	67-66-3	0.20	0.01
Chloromethane	74-87-3	0.50	0.01
Cis-1, 2-Dichloroethene	156-59-2	1.0	0.01
Cis-1, 3-Dichloropropene	10061-01-5	0.50	0.01
Dibromochloromethane	124-48-1	0.50	0.01
Dibromomethane	74-95-3	1.0	0.01
Dichlorodifluoromethane	75-71-8	1.0	0.01
Ethylbenzene	100-41-4	1.0	0.01
Hexachlorobutadiene	87-68-3	0.60	0.01
Isopropylbenzene	98-82-8	0.50	0.01
m-Xylene	108-38-3	2.0	0.01
Methylene Chloride	75-09-2	1.0	0.01
n-Butylbenzene	104-51-8	1.0	0.01
n-Propylbenzene	103-65-1	1.0	0.01
Naphthalene	91-20-3	1.0	0.01
o-Xylene	95-47-6	1.0	0.01
p-Isopropyltoluene	99-87-6	1.0	0.01
p-Xylene	106-42-3	2.0	0.01
Sec-Butylbenzene	135-98-8	1.0	0.01
Styrene	100-42-5	1.0	0.01
Trichloroethene	79-01-6	0.50	0.01
Tert-Butylbenzene	98-06-6	1.0	0.01
Tetrachloroethylene	127-18-4	0.50	0.01
Toluene	108-88-3	1.0	0.01
Trans-1, 2-Dichloroethene	156-60-5	1.0	0.01
Trans-1, 3-Dichloropropene	10061-02-6	1.0	0.01
Trichlorofluoromethane	75-69-4	1.0	0.01
Vinyl Chloride	75-01-4	0.40	0.01
Xylenes, Total	1330-20-7	1.0	0.01

Table B.5.1.3-2 Method SW8021B QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
1,1,1,2-Tetrachloroethane	75-125	≤ 20	65-125	≤ 30
1,1,1-Trichloroethane	69-134	≤ 20	59-134	≤ 30
1,1,2,2-Tetrachloroethane	30-166	≤ 20	25-166	≤ 30
1,1,2-Trichloroethane	61-130	≤ 20	51-130	≤ 30
1,1-Dichloroethane	64-127	≤ 20	54-127	≤ 30
1,1-Dichloroethene	53-147	≤ 20	43-147	≤ 30
1,1-Dichloropropene	65-135	≤ 20	55-145	≤ 30
1,2,3-Trichlorobenzene	65-135	≤ 20	55-145	≤ 30
1,2,3-Trichloropropane	75-125	≤ 20	65-125	≤ 30
1,2,4-Trichlorobenzene	65-135	≤ 20	55-145	≤ 30
1,2,4-Trimethylbenzene	65-135	≤ 20	55-145	≤ 30
1,2-Dibromo-3-chloropropane	65-135	≤ 20	55-145	≤ 30
1,2-Dibromoethane	65-135	≤ 20	55-145	≤ 30
1,2-Dichloroethane	68-137	≤ 20	58-137	≤ 30
1,2-Dichlorobenzene	61-134	≤ 20	51-134	≤ 30
1,2-Dichloropropane	73-125	≤ 20	63-125	≤ 30
1,3,5-Trimethylbenzene	65-135	≤ 20	55-145	≤ 30
1,3-Dichlorobenzene	63-137	≤ 20	53-137	≤ 30
1,3-Dichloropropane	65-135	≤ 20	55-145	≤ 30
1,4-Dichlorobenzene	66-135	≤ 20	56-135	≤ 30
2,2-Dichloropropane	65-135	≤ 20	55-145	≤ 30
2-Chlorotoluene	65-135	≤ 20	55-145	≤ 30
4-Chlorotoluene	65-135	≤ 20	55-145	≤ 30
Benzene	75-125	≤ 20	65-125	≤ 30
Bromobenzene	75-125	≤ 20	65-125	≤ 30
Bromochloromethane	65-135	≤ 20	55-145	≤ 30
Bromodichloromethane	61-135	≤ 20	51-135	≤ 30
Bromoform	58-129	≤ 20	48-129	≤ 30
Bromomethane	68-125	≤ 20	58-125	≤ 30
Carbon Tetrachloride	69-139	≤ 20	59-139	≤ 30
Chlorobenzene	75-129	≤ 20	65-129	≤ 30
Chloroethane	75-130	≤ 20	65-130	≤ 30
Chloroform	49-133	≤ 20	39-133	≤ 30

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Chloromethane	59-154	≤ 20	49-154	≤ 30
Cis-1,2-Dichloroethene	75-120	≤ 20	65-125	≤ 30
Cis-1,3-Dichloropropene	75-130	≤ 20	65-130	≤ 30
Dibromochloromethane	75-131	≤ 20	65-131	≤ 30
Dibromomethane	65-135	≤ 20	55-145	≤ 30
Dichlorodifluoromethane	68-125	≤ 20	58-125	≤ 30
Ethylbenzene	71-129	≤ 20	61-129	≤ 30
Hexachlorobutadiene	65-135	≤ 20	55-145	≤ 30
Isopropylbenzene	65-135	≤ 20	55-145	≤ 30
m-Xylene	65-135	≤ 20	55-145	≤ 30
Methylene Chloride	42-176	≤ 20	32-176	≤ 30
n-Propylbenzene	65-135	≤ 20	55-145	≤ 30
Naphthalene	65-135	≤ 20	55-145	≤ 30
o-Xylene	65-135	≤ 20	55-145	≤ 30
p-Isopropyltoluene	65-135	≤ 20	55-145	≤ 30
p-Xylene	65-135	≤ 20	55-145	≤ 30
Sec-Butylbenzene	65-135	≤ 20	55-145	≤ 30
Styrene	65-135	≤ 20	55-145	≤ 30
Trichloroethene	75-141	≤ 20	65-141	≤ 30
Tert-Butylbenzene	65-135	≤ 20	55-145	≤ 30
Tetrachloroethene	75-142	≤ 20	65-142	≤ 30
Toluene	70-125	≤ 20	60-125	≤ 30
Trans-1,2-Dichloroethene	75-130	≤ 20	68-130	≤ 30
Trans-1,3-Dichloropropene	42-156	≤ 20	32-156	≤ 30
Trichlorofluoromethane	75-130	≤ 20	69-130	≤ 30
Vinyl Chloride	47-142	≤ 20	37-142	≤ 30
Xylenes, Total	71-133	≤ 20	61-133	≤ 30
Surrogates:				
1,4-Dichlorobutane	35-135		35-135	
Bromochlorobenzene	37-137		37-137	

Table B.5.1.3-3 Method SW8021B Calibration and QC Procedures for Aromatic/Halogenated Volatile Organics

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	linear - RSD for all analytes $\leq 20\%$ linear - least squares regression $r \geq 0.995$ for each analyte non-linear - COD ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	± 3 times standard deviation for each average analyte retention time from 72-hour study or 0.03 minutes, whichever is greater.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using 4 replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.3-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.3-2.	Correct problem then reprep and analyze the LCS and all samples in the affected batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.3-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.3-2.	Describe in LRC.
Second-column confirmation.	100% for all positive results.	Same as for initial or primary column analysis. RPD for the dual column results $\leq 40\%$.	Describe in LRC. If no chromatographic anomalies or problems noted, report the lower result as per Section 11.10.4.2 of Method 8000C.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.3-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.4 *Method SW8070A-Nitrosamines*

Select nitrosamines in water and soil samples are analyzed using Method SW8070A. The sample is extracted and analyzed by gas chromatography.

Table B.5.1.4-1 Method SW8070A MQLs for Nitrosamines

Analyte, CAS No.	Water MQL (µg/L)	Soil MQL (mg/kg)
N-Nitrosodi-n-propylamine, 621-64-7	2.0	4.0
N-Nitrosodimethylamine, 62-75-9	0.50	1.0
N-Nitrosodiphenylamine, 86-30-6	3.0	6.0

Table B.5.1.4-2 Method SW8070A QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
N-Nitrosodi-n-propylamine	45–146	≤ 30	35–146	≤ 50
N-Nitrosodimethylamine	25–125	≤ 30	25–135	≤ 50
N-Nitrosodiphenylamine	25–139	≤ 30	25–149	≤ 50
Surrogates ^a				

- a. For the surrogate, use an analyte, and its LCS limit, from the method that is not expected to be present in the sample.

Table B.5.1.4-3 Method SW8070A Calibration and QC Procedures for Nitrosamines

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes	Initial calibration prior to sample analysis.	linear – all analytes RSD ≤ 20% . linear – least squares regression non-linear – COD ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within ±20% of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	±3 times standard deviation for each analyte retention time from 72-hour study or 0.03 minutes, whichever is greater.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis.	All analytes within ±20% of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within ±20% of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.4-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected ≥ MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.4-2.	Reprep and analyze the LCS and all samples in the affected analytical batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.4-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.4-2.	Describe in LRC.
Second-column confirmation.	100% for all positive results.	Same as for initial or primary column analysis.	Same as for initial or primary column analysis.
MDL study.	Once per 12 month period.	Detection limits established shall be ≤ ½ the MQLs in Table B.5.1.4-1.	If the MDL study does not meet the acceptance criteria, repeat MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.5 *Method SW8081B-Organochlorine Pesticides*

Organochlorine pesticides in water and soil samples are analyzed using Method SW8081B. This analytical method includes the extraction procedure for the samples. The pesticides are then separated and quantified by GC using electron capture detection.

A second-column confirmation is not required for the analysis of toxaphene or chlordane.

Table B.5.1.5-1 Method SW8081B MQLs for Organochlorine Pesticides

Analyte, CAS No.	Water MQL (ug/L)	Soil MQL (mg/kg)
alpha-BHC, 319-84-6	0.1	0.004
beta-BHC, 319-85-7	0.1	0.004
delta-BHC, 319-86-8	0.1	0.004
gamma-BHC (Lindane), 58-89-9	0.1	0.004
alpha-Chlordane, 5103-71-9	0.1	0.004
gamma-Chlordane, 5103-74-2	0.1	0.004
4,4'-DDD, 72-54-8	0.1	0.004
4,4'-DDE, 72-55-9	0.1	0.004
4,4'-DDT, 50-29-3	0.1	0.004
Aldrin, 309-00-2	0.1	0.004
Dieldrin, 60-57-1	0.1	0.004
Endosulfan I, 959-98-8	0.1	0.004
Endosulfan II, 33213-65-9	0.1	0.004
Endosulfan Sulfate, 1031-07-8	0.1	0.004
Endrin, 72-20-8	0.1	0.004
Endrin Aldehyde, 7421-93-4	0.1	0.004
Heptachlor, 76-44-8	0.1	0.004
Heptachlor Epoxide, 1024-57-3	0.1	0.004
Methoxychlor, 72-43-5	0.5	0.02
Toxaphene, 8001-35-2	1.0	0.10

Table B.5.1.5-2 Method SW8081B QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
alpha-BHC	60-128	≤30	62-125	≤ 50
beta-BHC	66-126	≤30	62-127	≤ 50
delta-BHC	46-136	≤30	57-130	≤ 50
gamma-BHC (Lindane)	30-146	≤30	59-123	≤ 50
alpha-Chlordane	63-123	≤30	63-121	≤ 50
gamma-Chlordane	67-120	≤30	48-124	≤ 50
4,4'-DDD	50-139	≤30	50-139	≤ 50
4,4'-DDE	48-137	≤30	68-126	≤ 50
4,4'-DDT	47-138	≤30	46-135	≤ 50
Aldrin	42-138	≤30	47-120	≤ 50
Dieldrin	62-129	≤30	67-125	≤ 50
Endosulfan I	49-120	≤30	41-147	≤ 50
Endosulfan II	42-130	≤30	37-141	≤ 50
Endosulfan Sulfate	54-137	≤30	62-135	≤ 50
Endrin	56-134	≤30	61-133	≤ 50
Endrin Aldehyde	56-137	≤30	37-147	≤ 50
Heptachlor	51-128	≤30	51-140	≤ 50
Heptachlor Epoxide	62-131	≤30	66-130	≤ 50
Methoxychlor	56-150	≤30	57-143	≤ 50
Toxaphene	41-126	≤30	31-136	≤ 50
Surrogates:				
Decachlorobiphenyl	32-135		56-132	
Tetrachloro-m-xylene	33-138		69-124	

Table B.5.1.5-3 Method SW8081B Calibration and QC Procedures for Organochlorine Pesticides

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	linear – Analyte RSD \leq 20%. linear – least squares regression $r \geq$ 0.995 for each analyte. non-linear – COD \geq 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat initial calibration.
Second-source calibration verification for all analytes.	Once per five-point initial calibration.	All analytes within \pm 20% of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	\pm 3 times standard deviation for each analyte retention time from 72-hour study or 0.03 minutes, whichever is greater.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis.	All analytes within \pm 20% of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within \pm 20% of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Breakdown check (Endrin and DDT).	Daily prior to analysis of samples.	Degradation \leq 15%.	Take corrective action prior to calibration. Repeat breakdown check.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.5-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.5-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.5-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.5-2.	Describe in LRC.
Second-column confirmation (excluding toxaphene and chlordane).	100% for all positive results.	Same as for initial or primary column analysis. RPD for the dual column results \leq 40%.	Describe in LRC. If no chromatographic anomalies or problems noted, report the lower result as per Section 11.10.4.2 of Method 8000C.
MDL study.	Once per 12 month period.	Detection limits established shall be \leq $\frac{1}{2}$ the MQLs in Table B.5.1.5-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.6 *Method SW8082A-Polychlorinated Biphenyls (PCBs)*

PCBs in water and soil samples are analyzed using Method SW8082A. This analytical method involves the extraction of the samples. The PCBs are then separated and quantified by GC using electron capture detection or electrolytic conductivity detection.

Aroclor is a commonly known trade name for nine PCB mixtures produced from approximately 1930 to 1979. The name 'Aroclor' is usually followed by a 4 digit number indicating the level of chlorination in the mixture. A standard containing a mixture of Aroclor 1016 and Aroclor 1260 will include many of the peaks represented in the other five Aroclor mixtures. For analysis of PCBs, a multi-point initial calibration employing a mixture of Aroclors 1016 and 1260 at five concentrations should be sufficient to demonstrate the linearity of the detector response without the necessity of performing initial calibrations for each of the seven Aroclors. In addition, such a mixture can be used as a standard to demonstrate that a sample does not contain peaks that represent any one of the Aroclors. Retention times shall be verified for all analytes during the initial five point calibration. Single standards of each of the other five Aroclors are required to aid the analyst in pattern recognition and to determine the calibration factor for each Aroclor. The daily calibration, initial calibration verification, and the calibration verification should be performed in accordance with the provisions of Method SW8082A. The LCS and MS/MSD may only be spiked with the 1016/1260 mix. A second-column confirmation is not required.

When PCBs are to be quantitatively determined as individual congeners, the laboratory must submit for approval by the TCEQ QAS a list of the congeners to be determined along with the calibration and QC procedures to be performed in Section 6 of the site-specific FSP.

Table B.5.1.6-1 Method SW8082A MQLs for PCBs

Analyte, CAS No.	Water MQL (ug/L)	Soil MQL (mg/kg)
Aroclor 1016, 12674-11-2	0.5	0.05
Aroclor 1221, 11104-28-2	0.5	0.05
Aroclor 1232, 11141-16-5	0.5	0.05
Aroclor 1242, 53469-21-9	0.5	0.05
Aroclor 1248, 12672-29-6	0.5	0.05
Aroclor 1254, 11097-69-1	0.5	0.05
Aroclor 1260, 11096-82-5	0.5	0.05
2-Chlorobiphenyl, 2051-60-7	0.5	0.05
2,3-Dichlorobiphenyl, 16605-91-7	0.5	0.05
2,4',5'-Trichlorobiphenyl, 16606-02-3	0.5	0.05
2,2',3,5'-Tetrachlorobiphenyl, 41464-39-5	0.5	0.05
2,2',5,5'-Tetrachlorobiphenyl, 35693-99-3	0.5	0.05
2,3',4,4'-Tetrachlorobiphenyl, 32598-10-0	0.5	0.05
2,2',5-Trichlorobiphenyl, 37680-65-2	0.5	0.05
2,2',3,4,5'-Pentachlorobiphenyl, 38380-02-8	0.5	0.05
2,2',4,5,5'-Pentachlorobiphenyl, 37680-73-2	0.5	0.05
2,3,3',4',6-Pentachlorobiphenyl, 38380-03-9	0.5	0.05
2,2',3,4,4',5'-Hexachlorobiphenyl, 35065-28-2	0.5	0.05
2,2',3,4,5,5'-Hexachlorobiphenyl, 52712-04-6	0.5	0.05
2,2',3,5,5',6-Hexachlorobiphenyl, 52663-63-5	0.5	0.05
2,2',4,4',5,5'-Hexachlorobiphenyl, 35065-27-1	0.5	0.05
2,2',3,3',4,4',5-Heptachlorobiphenyl, 35065-30-6	0.5	0.05
2,2',3,4,4',5,5'-Heptachlorobiphenyl, 35065-29-3	0.5	0.05
2,2',3,4,4',5',6-Heptachlorobiphenyl, 52663-69-1	0.5	0.05
2,2',3,4',5,5',6-Heptachlorobiphenyl, 52663-68-0	0.5	0.05
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl, 40186-72-9	0.5	0.05

Table B.5.1.6-2 Method SW8082A QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Aroclor 1016	40-144	≤30	41-138	≤ 50
Aroclor 1221	41-136	≤30	45-136	≤ 50
Aroclor 1232	41-136	≤30	45-136	≤ 50
Aroclor 1242	39-150	≤30	43-150	≤ 50
Aroclor 1248	41-136	≤30	44-136	≤ 50
Aroclor 1254	29-141	≤30	41-141	≤ 50
Aroclor 1260	45-145	≤30	61-131	≤ 50
1016/1260 Mix	50-135	≤30	40-130	≤ 50
Surrogate: Decachlorobiphenyl	42-133		58-125	

Table B.5.1.6-3 Method SW8082A Calibration and QC Procedures for PCBs

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration.	Initial calibration prior to sample analysis.	linear - RSD for all analytes $\leq 20\%$.	Correct problem then repeat initial calibration.
Five-point initial calibration.	Initial calibration prior to sample analysis.	linear – least squares regression $r \geq 0.995$ for each analyte.	Correct problem then repeat initial calibration.
Second-source calibration verification for PCB 1016/1260 mix.	Once per five-point initial calibration.	Mix within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for PCB 1016/1260 mix.	Each initial calibration and calibration verifications.	± 3 times standard deviation for each analyte retention time from 72-hour study or 0.03 minutes, whichever is greater.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification for PCB 1016/1260 mix.	Daily, before sample analysis.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification for PCB 1016/1260 mix.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.6-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS (1016/1260 mix).	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.6-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.6-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD (1016/1260 mix).	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.6-2.	Describe in LRC.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.6-1.	If MDL study does not meet the acceptance criteria, repeat the MDL study.

a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.7 *Method SW8141B-Organophosphorus Pesticides*

Method SW8141B is a GC method used to determine the concentrations of various organophosphorus pesticides. This analytical method involves extraction of the samples. An aliquot of the extract is injected into a GC and compounds in the GC effluent are detected with a flame photometric or nitrogen-phosphorus detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column.

Table B.5.1.7-1 Method SW8141B MQLs for Organophosphorus Pesticides

Analyte, CAS No.	Water MQL (ug/L)	Soil MQL (mg/kg)
Azinphos Methyl, 86-50-0	1.0	0.05
Bolstar, 35400-43-2	0.7	0.04
Chlorpyrifos, 2921-88-2	0.7	0.05
Coumaphos, 56-72-4	2.0	0.10
Demeton-o, 8065-48-3	1.2	0.06
Demeton-s, 8065-48-3	1.2	0.06
Diazinon, 333-41-5	2.0	0.10
Dichlorovos, 62-73-7	2.0	0.04
Disulfoton, 298-04-4	0.7	0.04
Ethoprop, 13194-48-4	2.0	0.10
Fensulfothion, 115-90-2	0.8	0.04
Fenthion, 55-38-9	0.8	0.05
Merphos, 150-50-5	2.0	0.10
Mevinphos, 7786-34-7	5.0	0.25
Naled, 300-76-5	5.0	0.25
Parathion Methyl, 298-00-0	1.2	0.06
Phorate, 298-02-2	0.4	0.02
Ronnel, 299-84-3	0.7	0.04
Stirophos, 22248-79-9	8.0	0.40
Tokuthion, 34643-46-4	0.7	0.06
Trichloronate, 327-98-0	8.0	0.40

Table B.5.1.7-2 Method SW8141B QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Azinphos Methyl	50-150	≤30	40-160	≤ 50
Bolstar	46-125	≤30	36-135	≤ 50
Chlorpyrifos	75-125	≤30	65-135	≤ 50
Coumaphos	71-147	≤30	61-157	≤ 50
Demeton-o	50-150	≤30	40-160	≤ 50
Demeton-s	50-150	≤30	40-160	≤ 50
Diazinon	47-149	≤30	37-159	≤ 50
Dichlorovos	49-125	≤30	39-135	≤ 50
Disulfoton	50-150	≤30	40-160	≤ 50
Ethoprop	75-125	≤30	65-135	≤ 50
Fensulfothion	43-145	≤30	33-155	≤ 50
Fenthion	25-125	≤30	25-135	≤ 50
Merphos	75-144	≤30	65-154	≤ 50
Mevinphos	33-125	≤30	25-135	≤ 50
Naled	54-125	≤30	44-135	≤ 50
Parathion Methyl	45-130	≤30	35-140	≤ 50
Phorate	50-150	≤30	40-160	≤ 50
Ronnel	75-125	≤30	65-135	≤ 50
Stirophos	48-125	≤30	38-135	≤ 50
Tokuthion	44-125	≤30	34-135	≤ 50
Trichloronate	49-161	≤30	39-171	≤ 50
<i>Surrogates:</i>				
Tributyl Phosphate	67-136		57-146	
Triphenyl Phosphate	65-134		55-144	

Table B.5.1.7-3 Method SW8141B Calibration and QC Procedures
Summary for Organophosphorus Pesticides

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	linear - Analytes RSD $\leq 20\%$. linear - least squares regression $r \geq 0.995$ for each analyte. non-linear - COD ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	± 3 times standard deviation for each analyte retention time from 72-hour study or 0.03 minutes, whichever is greater.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.7-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.7-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.7-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.7-2.	Describe in LRC.
Second-column confirmation.	100% for all positive results.	Same as for initial or primary column analysis. RPD for the dual column results $\leq 40\%$.	Describe in LRC. If no chromatographic anomalies or problems noted, report the lower result as per Section 11.10.4.2 of Method 8000C.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.7-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.8 *Method SW8151A-Chlorinated Herbicides*

Method SW8151A is a capillary GC method for determining selected chlorinated acid herbicides and related compounds. Samples are extracted then esterified in accordance with the method. The esters are determined by GC employing an electron capture detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column.

Table B.5.1.8-1 Method SW8151A MQLs for Chlorinated Herbicides

Analyte, CAS No.	Water MQL (ug/L)	Soil MQL (mg/kg)
2,4-D, 94-75-7	10	0.2
2,4-DB, 94-82-6	20	0.5
2,4,5-T, 93-76-5	20	0.5
2,4,5-TP (silvex), 93-72-1	10	0.2
Dalapon, 75-99-0	30	0.8
Dicamba, 1918-00-9	20	0.5
Dichloroprop, 120-36-5	20	0.5
Dinoseb, 88-85-7	3	0.1
MCPA, 94-74-6	1	10
MCP, 93-65-2	50	15

Table B.5.1.8-2 Method SW8151A QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
2,4-D	39-120	≤30	32-131	≤ 50
4-DB	44-120	≤30	42-145	≤ 50
2,4,5-T	44-122	≤30	43-139	≤ 50
2,4,5-TP	49-126	≤30	46-128	≤ 50
Dalapon	40-120	≤30	22-125	≤ 50
Dicamba	60-120	≤30	56-120	≤ 50
Dichloroprop	68-122	≤30	72-142	≤ 50
Dinoseb	28-115	≤30	20-131	≤ 50
MCPA	62-144	≤30	65-120	≤ 50
MCP	60-133	≤30	60-118	≤ 50
Surrogate:				
2,4-Dichlorophenylacetic acid	50-130		45-140	

Table B.5.1.8-3 Method SW8151A Calibration and QC Procedures for Chlorinated Herbicides

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	linear - Analyte RSD $\leq 20\%$. linear - least squares regression $r \geq 0.995$ for each analyte. non-linear - COD ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	± 3 times standard deviation for each analyte retention time from 72-hour study or 0.03 minutes, whichever is greater.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.8-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.8-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.8-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.8-2.	Describe in LRC.
Second-column confirmation.	100% for all positive results.	Same as for initial or primary column analysis. RPD for the dual column results $\leq 40\%$.	Describe in LRC. If no chromatographic anomalies or problems noted, report the lower result as per Section 11.10.4.2 of Method 8000C.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.8-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.9 *Method SW8260C-Volatile Organics*

Volatile (or purgeable) organics in water and soil samples are analyzed using Method SW8260C. This method uses a capillary column GC/mass spectrometry technique. Volatile compounds are introduced into the GC by purge and trap (SW5030C for water or SW5035A for soil). An inert gas is bubbled through the water samples (or a soil-water slurry for soil samples) to transfer the purgeable organic compounds from the liquid to vapor phase. Soil samples with higher contaminant levels are extracted using methanol before purging. The vapor is then swept through a sorbent trap where the purgeable organics are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a capillary GC column where they are separated and then detected with a mass spectrometer.

The mass spectrometer is tuned daily to give an acceptable spectrum for bromofluorobenzene (BFB). The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- mass 50 15 percent to 40 percent of mass 95
- mass 75 30 percent to 60 percent of mass 95
- mass 95 base peak, 100 percent relative abundance
- mass 96 5 percent to 9 percent of mass 95
- mass 173 less than 2 percent of mass 174
- mass 174 greater than 50 percent of mass 95
- mass 175 5 percent to 9 percent of mass 174
- mass 176 greater than 95 percent but less than 101 percent of mass 174
- mass 177 5 percent to 9 percent of mass 176

The internal standard (IS) method is used for quantitation of analytes of interest. For quantitation, response factors (RFs) are calculated from the base ion peak of a specific IS added to each calibration standard, blank, QC sample, and sample.

In addition to the target analytes listed in Table B.5.1.9-1, Method SW8260C includes performing library searches for up to ten tentatively identified compounds (TICs).

Table B.5.1.9-1 Method SW8260C MQLs for Volatile Organics

Analyte, CAS No.	Water MQL (ug/L)	Soil MQL (mg/kg)
1,1,1,2-Tetrachloroethane, 630-20-6	0.5	0.003
1,1,1-Trichloroethane, 71-55-6	1.0	0.005
1,1,2,2-Tetrachloroethane, 79-34-5	0.5	0.003
1,1,2-Trichloroethane, 79-00-5	1.0	0.005
1,1-Dichloroethane, 75-34-3	1.0	0.005
1,1-Dichloroethene, 75-35-4	1.0	0.006
1,1-Dichloropropene, 563-58-6	1.0	0.005
1,2,3-Trichlorobenzene, 87-61-6	1.0	0.005
1,2,3-Trichloropropane, 96-18-4	1.0	0.005
1,2,4-Trichlorobenzene, 120-82-1	1.0	0.005
1,2,4-Trimethylbenzene, 95-63-6	1.0	0.006
1,2-Dichloroethane, 107-06-2	0.5	0.003
1,2-Dichlorobenzene, 95-50-1	1.0	0.005
1,2-Dibromo-3-chloropropane, 96-12-8	2.0	0.01
1,2-Dichloropropane, 78-87-5	1.0	0.005
1,2-Ethylene dibromide, 106-93-4	1.0	0.005
1,3,5-Trimethylbenzene, 108-67-8	1.0	0.005
1,3-Dichlorobenzene, 541-73-1	1.0	0.006
1,3-Dichloropropane, 142-28-9	0.4	0.002
1,4-Dichlorobenzene, 106-46-7	0.5	0.002
1,4-Dioxane, 123-91-1	5.0 ^a	0.005 ^a
1-Chlorohexane, 544-10-5	1.0	0.005
2,2-Dichloropropane, 594-20-7	1.0	0.005
2-Chlorotoluene, 95-49-8	1.0	0.005
4-Chlorotoluene, 106-43-4	1.0	0.005
Acetone, 67-64-1	10	0.05
Benzene, 71-43-2	0.4	0.002
Bromobenzene, 108-86-1	1.0	0.005
Bromochloromethane, 74-97-5	1.0	0.005
Bromodichloromethane, 75-27-4	0.5	0.002
Bromoform, 75-25-2	1.0	0.006
Bromomethane, 74-83-9	3.0	0.01
Carbon disulfide, 75-15-0	1.0	0.01
Carbon tetrachloride, 56-23-5	1.0	0.005
Chlorobenzene, 108-90-7	0.5	0.002
Chloroethane, 75-00-3	1.0	0.005
Chloroform, 67-66-3	0.3	0.002
Chloromethane, 74-87-3	1.0	0.005
Cyclohexane, 110-82-7	1.0	0.01
Cis-1,2-Dichloroethene, 156-59-2	1.0	0.005
Cis-1,3-Dichloropropene, 10061-01-5	0.5	0.003
Dibromochloromethane, 124-48-1	0.5	0.003
Dibromomethane, 74-95-3	1.0	0.005
Dichlorodifluoromethane, 75-71-8	1.0	0.005

Analyte, CAS No.	Water MQL (ug/L)	Soil MQL (mg/kg)
Ethylbenzene, 100-41-4	1.0	0.005
Hexachlorobutadiene, 87-68-3	0.6	0.003
2-Hexanone, 591-78-6	1.0	0.01
Isopropylbenzene, 98-82-8	1.0	0.005
m-Xylene, 108-38-3	2.0	0.005
Methyl acetate, 79-20-9	1.0	0.01
Methylcyclohexane, 108-87-2	1.0	0.01
Methyl isobutyl ketone, 108-10-1	10	0.02
Methyl ethyl ketone, 78-93-3	10	0.02
Methyl tert-butyl ether, 1634-04-4	5.0	0.02
Methylene chloride, 75-09-2	1.0	0.005
n-Butylbenzene, 104-51-8	1.0	0.005
n-Propylbenzene, 103-65-1	1.0	0.005
Naphthalene, 91-20-3	1.0	0.005
o-Xylene, 95-47-6	1.0	0.005
p-Isopropyltoluene, 99-87-6	1.0	0.006
p-Xylene, 106-42-3	2.0	0.005
Sec-Butylbenzene, 135-98-8	1.0	0.005
Styrene, 100-42-5	1.0	0.005
Trichloroethene, 79-01-6	1.0	0.005
Tert-Butylbenzene, 98-06-6	1.0	0.005
Tetrachloroethene, 127-18-4	1.0	0.005
Toluene, 108-88-3	1.0	0.005
Trans-1,2-Dichloroethene, 156-60-5	1.0	0.005
Trans-1,3-Dichloropropene, 10061-02-6	1.0	0.005
Trichlorofluoromethane, 75-69-4	1.0	0.005
1,1,2-Trichloro-1,2,2-trifluoroethane, 76-13-1	1.0	0.01
Vinyl chloride, 75-01-4	1.0	0.005

- a. To achieve the aqueous and soil MQLs for 1,4-dioxane cited in this table, the laboratory will perform either a low-level SW8260C analysis or a modified SW8260C analysis with select ion monitoring (SIM).

Table B.5.1.9-2 Method SW8260C QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
1,1,1,2-Tetrachloroethane	81-129	≤ 20	74-125	≤30
1,1,1-Trichloroethane	67-132	≤20	68-130	≤30
1,1,2,2-Tetrachloroethane	63-128	≤20	59-140	≤30
1,1,2-Trichloroethane	75-125	≤20	62-127	≤30
1,1-Dichloroethane	69-133	≤20	73-125	≤30
1,1-Dichloroethene	68-130	≤ 20	65-136	≤30
1,1-Dichloropropene	73-132	≤20	70-135	≤30
1,2,3-Trichlorobenzene	67-137	≤20	62-133	≤30
1,2,3-Trichloropropane	73-124	≤20	63-130	≤30
1,2,4-Trichlorobenzene	66-134	≤20	65-131	≤30
1,2,4-Trimethylbenzene	74-132	≤ 20	65-135	≤30
1,2-Dichloroethane	69-132	≤20	72-137	≤30
1,2-Dichlorobenzene	71-122	≤20	74-120	≤30
1,2-Dibromo-3-chloropropane	50-132	≤20	49-135	≤30
1,2-Dichloropropane	75-125	≤20	71-120	≤30
1,2-Ethylene dibromide	80-121	≤ 20	70-124	≤30
1,3,5-Trimethylbenzene	74-131	≤20	65-133	≤30
1,3-Dichlorobenzene	75-124	≤20	72-124	≤30
1,3-Dichloropropane	73-126	≤20	76-123	≤30
1,4-Dichlorobenzene	74-123	≤20	72-125	≤30
1,4-Dioxane	60-130	≤20	60-135	≤30
1-Chlorohexane	70-125	≤ 20	60-135	≤30
2,2-Dichloropropane	69-137	≤20	67-134	≤30
2-Chlorotoluene	73-126	≤20	69-128	≤30
4-Chlorotoluene	74-128	≤20	73-126	≤30
Acetone	40-135	≤20	40-141	≤30
Benzene	81-122	≤ 20	73-126	≤30
Bromobenzene	76-124	≤20	66-121	≤30
Bromochloromethane	65-129	≤20	71-127	≤30
Bromodichloromethane	76-121	≤20	72-128	≤30
Bromoform	69-128	≤20	66-137	≤30
Bromomethane	53-141	≤ 20	45-141	≤30
Carbon disulfide	10-200	≤20	10-200	≤30
Carbon tetrachloride	66-138	≤20	67-133	≤30
Chlorobenzene	81-122	≤20	75-123	≤30
Chloroethane	58-133	≤20	41-141	≤30
Chloroform	69-128	≤ 20	72-124	≤30
Chloromethane	56-131	≤20	51-129	≤30
Cyclohexane	10-200	≤20	10-200	≤30

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Cis-1,2-Dichloroethene	72-126	≤20	67-125	≤30
Cis-1,3-Dichloropropene	69-131	≤20	72-126	≤30
Dibromochloromethane	66-133	≤ 20	66-130	≤30
Dibromomethane	76-125	≤20	73-128	≤30
Dichlorodifluoromethane	53-153	≤20	34-136	≤30
Ethylbenzene	73-127	≤20	74-127	≤30
Hexachlorobutadiene	67-131	≤20	53-142	≤30
2-Hexanone	50-150	≤ 20	50-150	≤30
Isopropylbenzene	75-127	≤20	77-129	≤30
m-Xylene	76-128	≤20	79-126	≤30
Methyl acetate	50-150	≤20	50-150	≤30
Methylcyclohexane	10-200	≤20	10-200	≤30
Methyl isobutyl ketone	58-134	≤ 20	47-147	≤30
Methyl ethyl ketone	49-136	≤20	40-135	≤30
Methyl tert-butyl ether	65-123	≤20	50-135	≤30
Methylene chloride	63-137	≤20	63-137	≤30
n-Butylbenzene	69-137	≤20	65-138	≤30
n-Propylbenzene	72-129	≤ 20	63-135	≤30
Naphthalene	54-138	≤20	51-135	≤30
o-Xylene	80-121	≤20	77-125	≤30
p-Isopropyltoluene	73-130	≤20	75-133	≤30
p-Xylene	76-128	≤20	79-126	≤30
Sec-Butylbenzene	72-127	≤ 20	63-132	≤30
Styrene	65-134	≤20	74-128	≤30
Trichloroethene	70-127	≤20	77-124	≤30
Tert-butylbenzene	70-129	≤20	65-132	≤30
Tetrachloroethene	66-128	≤20	67-139	≤30
Toluene	77-122	≤ 20	71-127	≤30
Trans-1,2-Dichloroethene	63-137	≤20	66-134	≤30
Trans-1,3-Dichloropropene	59-135	≤20	65-127	≤30
Trichlorofluoromethane	57-129	≤20	49-139	≤30
1,1,2-Trichloro-1,2,2-trifluoroethane	67-125	≤20	57-135	≤30
Vinyl Chloride	50-134	≤20	58-126	≤30
Surrogates:				
Toluene-d8	81-120		84-116	
4-Bromofluorobenzene	76-119		84-118	
1,2-Dichloroethane-d4	72-119		52-149	

Table B.5.1.9-3 Method SW8260C Calibration and QC Procedures for Volatile Organics

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	Meet minimum analyte RFs listed in Table 4 of method and %RSD for RFs for each analyte ≤ 20% and one option below. <u>option 1 linear</u> – RSD for all analytes ≤ 20%. <u>option 2 linear</u> – least squares regression $r \geq 0.995$ for each analyte. <u>option 3 non-linear</u> – COD≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within $\pm 30\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	Daily, before sample analysis and every 12 hours of analysis time.	Meet minimum analyte RFs as given in Table 4 of method and ≤ 20% difference (when using RFs) or drift (when using least squares regression or non-linear calibration).	Correct problem then repeat initial calibration.
Calibration verification.	Daily, before sample analysis and every 12 hours of analysis time.	All calibration analytes within $\pm 30\%$ of expected value.	Correct problem then repeat initial calibration.
Demonstrate ability to achieve acceptable accuracy and precision using four replicate QC check sample analyses.	Once per analyst.	QC acceptance criteria, Table B.5.1.9-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for the analytes that did not meet criteria.
Internal standards.	Immediately after or during data acquisition of calibration check standard.	Retention time ± 10 seconds from retention time of the mid-point std. in the ICAL. EICP area within -50% to $+100\%$ of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.9-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.9-2.	Describe in LRC.
Check of mass spectral ion intensities using BFB.	Prior to initial calibration and calibration verification.	Refer to criteria listed Element B.5.1.9.	Retune instrument and verify.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.9-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.9-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.10 *Method SW8270D-Semivolatile Organics*

Semivolatile organics (also known as base/neutral and acid extractables) in water and soil samples are analyzed using Method SW8270D. This technique determines quantitatively the concentration of a number of SVOCs. Samples are extracted and both base/neutral and acid extracts are then concentrated through evaporation. Compounds of interest are separated and quantified using a capillary column GC/mass spectrometer.

The mass spectrometer is tuned every 12 hours to give an acceptable spectrum for decafluorotriphenylphosphine (DFTPP). The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- mass 51 10 percent to 80 percent of mass 198
- mass 68 less than 2 percent of mass 69
- mass 70 less than 2 percent of mass 69
- mass 127 10 percent to 80 percent of base peak
- mass 197 less than 2 percent of mass 198
- mass 198 base peak, or greater than 50 percent of mass 442
- mass 199 5 percent to 9 percent of mass 198
- mass 275 10 percent to 60 percent of base peak
- mass 365 greater than 1 percent of mass 198
- mass 441 present, but less than 24 percent of mass 442
- mass 442 base peak, or greater than 50 percent of mass 198
- mass 443 15 percent to 24 percent of mass 442

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS that is added to each calibration standard, blank, QC sample, and sample.

Table B.5.1.10-1 includes the method quantitation limits for full scan GC/mass spectrometry and the method quantitation limits using select ion monitoring (SIM) analysis. In addition to the target analytes listed in Table B.5.1.10-1, full scan Method SW8270D includes performing library searches for up to twenty tentatively identified compounds (TICs).

Table B.5.1.10-1 Method SW8270D MQLs for Semivolatile Organics

Analyte, CAS No.	Water ^a MQL (ug/L)	Soil ^a MQL (mg/kg)
Base/Neutral Extractables		
2,4-Dinitrotoluene, 121-14-2	10.0 (0.3)	0.7 (0.02)
2,6-Dinitrotoluene, 606-20-2	10.0 (0.3)	0.7 (0.02)
2-Chloronaphthalene, 91-58-7	10.0 (0.3)	0.7 (0.02)
2-Methylnaphthalene, 91-57-6	10.0 (0.3)	0.7 (0.02)
2-Nitroaniline, 88-74-4	50.0 (1.3)	3.3 (0.08)
3-Nitroaniline, 99-09-2	50.0 (1.3)	3.3 (0.08)
3,3'-Dichlorobenzidine, 91-94-1	20.0 (0.5)	1.3 (0.03)
4-Bromophenyl phenyl ether, 101-55-3	10.0 (0.3)	0.7 (0.02)
4-Chloroaniline, 106-47-8	20.0 (0.5)	1.3 (0.03)
4-Chlorophenyl phenyl ether, 7005-72-3	10.0 (0.3)	0.7 (0.02)
4-Nitroaniline, 100-01-6	50.0 (1.3)	3.3 (0.08)
Acenaphthylene, 208-96-8	10.0 (0.3)	0.7 (0.02)
Acenaphthene, 83-32-9	10.0 (0.3)	0.7 (0.02)
Acetophenone, 98-86-2	10.0 (0.3)	0.3 (0.008)
Anthracene, 120-12-7	10.0 (0.3)	0.7 (0.02)
Atrazine, 1912-24-9	10.0 (0.3)	0.8 (0.02)
Benzaldehyde, 100-52-7	10.0 (0.3)	0.3 (0.008)
Benz(a)anthracene, 56-55-3	10.0 (0.3)	0.7 (0.02)
Benzo(a)pyrene, 50-32-8	10.0 (0.3)	0.7 (0.02)
Benzo(b)fluoranthene, 205-99-2	10.0 (0.3)	0.7 (0.02)
Benzo(k)fluoranthene, 207-08-9	10.0 (0.3)	0.7 (0.02)
Benzo(g,h,i)perylene, 191-24-2	10.0 (0.3)	0.7 (0.02)
Benzyl alcohol, 100-51-6	20.0 (0.5)	1.3 (0.03)
1,1'-Biphenyl, 92-52-4	10.0 (0.3)	0.3 (0.008)
Bis(2-chloroethoxy) methane, 111-91-1	10.0 (0.3)	0.7 (0.02)
Bis(2-chloroethyl) ether, 111-44-4	10.0 (0.3)	0.7 (0.02)
Bis(2-chloroisopropyl) ether, 108-60-1	10.0 (0.3)	0.7 (0.02)
Bis(2-ethylhexyl) phthalate, 117-81-7	10.0 (0.3)	0.7 (0.02)
Butyl benzyl phthalate, 85-68-7	10.0 (0.3)	0.7 (0.02)
Caprolactum, 105-60-2	10.0 (0.3)	0.3 (0.008)
Carbazole, 86-74-8	10.0 (0.3)	0.3 (0.008)
Chrysene, 218-01-9	10.0 (0.3)	0.7 (0.02)
Di-n-butyl phthalate, 84-74-2	10.0 (0.3)	0.7 (0.02)
Di-n-octyl phthalate, 117-84-0	10.0 (0.3)	0.7 (0.02)

Analyte, CAS No.	Water ^a MQL (ug/L)	Soil ^a MQL (mg/kg)
Dibenz(a,h)anthracene, 53-70-3	10.0 (0.3)	0.7 (0.02)
Dibenzofuran, 132-64-9	10.0 (0.3)	0.7 (0.02)
Diethyl phthalate, 84-66-2	10.0 (0.3)	0.7 (0.02)
Dimethyl phthalate, 131-11-3	10.0 (0.3)	0.7 (0.02)
Fluoranthene, 206-44-0	10.0 (0.3)	0.7 (0.02)
Fluorene, 86-73-7	10.0 (0.3)	0.7 (0.02)
Hexachlorobenzene, 118-74-1	10.0 (0.3)	0.7 (0.02)
Hexachlorobutadiene, 87-68-3	10.0 (0.3)	0.7 (0.02)
Hexachlorocyclopentadiene, 77-47-4	10.0 (0.3)	0.3 (0.008)
Hexachloroethane, 67-72-1	10.0 (0.3)	0.7 (0.02)
Indeno(1,2,3-cd)-pyrene, 193-39-5	10.0 (0.3)	0.7 (0.02)
Isophorone, 78-59-1	10.0 (0.3)	0.7 (0.02)
N-Nitrosodiphenylamine, 86-30-6	10.0 (0.3)	0.7 (0.02)
N-Nitrosodi-n-propylamine, 621-64-7	10.0 (0.3)	0.7 (0.02)
Naphthalene, 91-20-3	10.0 (0.3)	0.7 (0.02)
Nitrobenzene, 98-95-3	10.0 (0.3)	0.7 (0.02)
Phenanthrene, 85-01-8	10.0 (0.3)	0.7 (0.02)
Pyrene, 129-00-0	10.0 (0.3)	0.7 (0.02)
Acid Extractables		
2,4,5-Trichlorophenol, 95-95-4	50.0 (1.3)	3.3 (0.08)
2,4,6-Trichlorophenol, 88-06-2	10.0 (0.3)	0.3 (0.008)
2,4-Dichlorophenol, 120-83-2	10.0 (0.3)	0.3 (0.008)
2,4-Dimethylphenol, 105-67-9	10.0 (0.3)	0.3 (0.008)
2,4-Dinitrophenol, 51-28-5	50.0 (1.3)	3.3 (0.08)
2-Chlorophenol, 95-57-8	10.0 (0.3)	0.3 (0.008)
2-Methylphenol, 95-48-7	10.0 (0.3)	0.3 (0.008)
2-Nitrophenol, 88-75-5	10.0 (0.3)	0.3 (0.008)
4,6-Dinitro-2-methylphenol, 534-52-1	50.0 (1.3)	3.3 (0.08)
4-Chloro-3-methylphenol, 59-50-7	20.0 (0.5)	1.3 (0.03)
4-Methylphenol, 106-44-5	50.0 (1.3)	2.0 (0.05)
4-Nitrophenol, 100-02-7	50.0 (1.3)	1.6 (0.04)
Benzoic acid, 65-85-0	100 (2.5)	5.0 (0.13)
Pentachlorophenol, 87-86-5	50.0 (1.3)	3.3 (0.08)
Phenol, 108-95-2	10.0 (0.3)	0.3 (0.008)

^a The parenthetical value is the method quantitation limit for the compound using select ion monitoring (SIM) analysis. All QC checks specified in Table B.5.1.10-3 are applicable to SIM analysis as well.

Table B.5.1.10-2 Method SW8270D QC Acceptance Criteria

Analyte	Accuracy Water(% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
2,4-Dinitrotoluene	51-120	≤20	48-125	≤30
2,6-Dinitrotoluene	49-120	≤20	48-125	≤30
2-Chloronaphthalene	49-120	≤20	45-125	≤30
2-Methylnaphthalene	46-120	≤20	47-125	≤30
2-Nitroaniline	48-120	≤20	44-125	≤30
3,3'-Dichlorobenzidine	20-120	≤20	25-128	≤30
3-Nitroaniline	20-126	≤20	27-125	≤30
4-Bromophenyl phenyl ether	52-120	≤20	46-125	≤30
4-Chloroaniline	20-120	≤20	25-125	≤30
4-Chlorophenyl phenyl ether	50-120	≤20	47-125	≤30
4-Nitroaniline	36-120	≤20	34-125	≤30
Acenaphthylene	50-120	≤20	44-125	≤30
Acenaphthene	47-120	≤20	46-125	≤30
Anthracene	54-120	≤20	53-125	≤30
Benz(a)anthracene	56-100	≤20	52-125	≤30
Benzo(a)pyrene	53-120	≤20	50-125	≤30
Benzo(b)fluoranthene	45-124	≤20	45-125	≤30
Benzo(k)fluoranthene	45-124	≤20	45-125	≤30
Benzo(g,h,i)perylene	38-123	≤20	38-126	≤30
Benzyl alcohol	30-120	≤20	25-125	≤30
Bis(2-chloroethoxy) methane	46-120	≤20	43-125	≤30
Bis(2-chloroethyl) ether	37-120	≤20	38-125	≤30
Bis(2-chloroisopropyl) ether	26-131	≤20	25-125	≤30
Bis(2-ethylhexyl) phthalate	42-126	≤20	47-127	≤30
Butyl benzyl phthalate	46-120	≤20	49-125	≤30
Chrysene	55-120	≤20	53-125	≤30
Di-n-butyl phthalate	54-120	≤20	56-125	≤30
Di-n-octyl phthalate	37-137	≤20	41-132	≤30
Dibenz (a,h) anthracene	42-127	≤20	41-125	≤30
Dibenzofuran	54-120	≤20	51-125	≤30
Diethyl phthalate	41-120	≤20	50-125	≤30
Dimethyl phthalate	25-127	≤20	49-125	≤30
Fluoranthene	54-120	≤20	54-125	≤30
Fluorene	50-120	≤20	49-125	≤30
Hexachlorobenzene	52-120	≤20	47-125	≤30

Analyte	Accuracy Water(% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Hexachlorobutadiene	27-120	≤20	40-125	≤30
Hexachlorocyclopentadiene	41-125	≤20	31-135	≤30
Hexachloroethane	28-120	≤20	34-125	≤30
Indeno(1,2,3-c,d)pyrene	43-125	≤20	38-125	≤30
Isophorone	50-120	≤20	43-125	≤30
n-Nitrosodi-n-propylamine	34-128	≤20	40-125	≤30
n-Nitrosodiphenylamine	48-120	≤20	49-125	≤30
Naphthalene	39-120	≤20	40-125	≤30
Nitrobenzene	44-120	≤20	41-125	≤30
Phenanthrene	51-120	≤20	50-125	≤30
Pyrene	49-128	≤20	46-125	≤30
2,4,5-Trichlorophenol	49-120	≤20	49-125	≤30
2,4,6-Trichlorophenol	49-126	≤20	43-125	≤30
2,4-Dichlorophenol	48-120	≤20	45-125	≤30
2,4-Dimethylphenol	28-120	≤20	32-125	≤30
2,4-Dinitrophenol	25-130	≤20	25-132	≤30
2-Chlorophenol	37-120	≤20	44-125	≤30
2-Methylphenol	38-120	≤20	40-125	≤30
2-Nitrophenol	39-123	≤20	42-125	≤30
4,6-Dinitro-2-methylphenol	40-130	≤20	29-137	≤30
4-Chloro-3-methylphenol	47-120	≤20	46-125	≤30
4-Methylphenol	32-120	≤20	41-125	≤30
4-Nitrophenol	20-120	≤20	25-138	≤30
Benzoic acid	20-120	≤20	25-125	≤30
Pentachlorophenol	38-120	≤20	25-125	≤30
Phenol	20-120	≤20	39-125	≤30
Surrogates:				
2,4,6-Tribromophenol	42-124		36-126	
2-Fluorobiphenyl	48-120		43-125	
2-Fluorophenol	20-120		37-125	
Nitrobenzene-D5	41-120		37-125	
Phenol-D6	20-120		40-125	
p-Terphenyl-D14	51-135		32-125	

Table B.5.1.10-3 Method SW8270D Calibration and QC Procedures for Semivolatile Organics

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	Meet minimum analyte RFs as given in Table 4 of method and %RSD for RFs for each analyte $\leq 20\%$ and one option below. <u>option 1 linear</u> - RSD all analytes ≤ 20. <u>option 2 linear</u> - least squares regression $r \geq 0.995$ for each analyte. <u>option 3 non-linear</u> - COD ≥ 0.990 (6 points for second order, 7 points for third order).	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within $\pm 30\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	Daily, before sample analysis and every 12 hours of analysis time.	Meet minimum analyte RFs as given in Table 4 of method and $\leq 20\%$ difference (when using RFs) or drift (when using least squares regression or non-linear calibration).	Correct problem then repeat initial calibration.
Calibration verification.	Daily, before sample analysis and every 12 hours of analysis time.	All calibration analytes within $\pm 30\%$ of expected value.	Correct problem then repeat initial calibration.
Demonstrate ability to generate acceptable accuracy and precision using four QC check sample replicate analyses.	Once per analyst.	QC acceptance criteria, Table B.5.1.10-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Internal standards.	Immediately after or during data acquisition for each sample.	Retention time ± 30 seconds from retention time of the mid-point std. in the ICAL. EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.10-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.10-2.	Describe in LRC.
Check of mass spectral ion intensities using DFTPP.	Prior to initial calibration and calibration verification.	Refer to criteria listed in the method description (Element B.5.1.10).	Retune instrument and verify.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.10-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.10-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.11 *Method SW8280B-Polychlorinated Dibenzo-p-Dioxins
and Polychlorinated Dibenzofurans*

Method SW8280B is used to analyze for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in water, sediment, soil, and waste. This GC/mass spectrometry method uses matrix-specific extraction, analyte-specific cleanup, and high-resolution capillary column GC/low resolution mass spectrometry techniques to separate and identify the analytes of interest. The sensitivity of the method is dependent on the level of matrix interference. Selected cleanup methods may be used to reduce or eliminate interferences. Target analytes may include all congener classes, tetra- through octa-dioxins and furans. Achieved detection limits vary according to matrix and analyte. Because of the extreme toxicity of these compounds, the analyst must take appropriate precautions during preparation and analysis to prevent accidental exposure. Isomer specificity for all congeners cannot be achieved using the recommended GC column and conditions in Method SW8280B. Therefore, if a congener is not resolvable from other congeners during calibration or column performance check analyses and is identified as detectable on the primary column in a given sample analysis, then its presence and concentration shall be determined on another GC column that resolves the given congener.

Method SW8280B provides for sample- and analyte-specific estimated quantitation limit (EQL) calculations based on measured signal to noise ratios. Therefore, the numeric value associated with a non-detectable result shall be the EQL calculated as specified in the analytical method (depending on the type of response produced during analysis of a given sample), rather than the method detection limit (MDL).

In addition, a quantitation limit determination for each 2,3,7,8-substituted congener using the following procedure shall be substituted for the MDL determination and comparison to method quantitation limits specified in this QAPP.

Seven method blanks shall be analyzed within a seven consecutive day period during the 12 months preceding the analysis of samples within a given batch. It is acceptable for sample and standard analyses to be interspersed among these method blanks, but no additional method blank analyses shall be interspersed among the seven method blanks to be used for the quantitation limit evaluation. The maximum reported value (EQL for non-detects) shall be less than or equal to the MQL specified in Table B.5.1.11-1 and the mean of the reported values (EQL for non-detects) shall be less than or equal to one half of the MQL.

Method SW8280B specifies several quality control samples that are optional. For analyses under this QAPP, the following QC samples will be utilized:

- Performance check solutions will be analyzed in accordance with the method.
- GC column performance check samples will be analyzed in accordance with the method.
- No fortified field blank will be required.
- Matrix spike/duplicate samples will be analyzed at the frequency specified in the method.
- Laboratory duplicate sample analyses will not be required.
- Field duplicate analyses will be conducted at the frequency specified in Section 4 of the FSP.

Table B.5.1.11-1 Method SW8280B MQLs for Dioxins/Furans

Analyte	Water MQL (ng/L)	Soil MQL (ug/kg)
2,3,7,8-PCDDs	4.4	1.7
2,3,7,8-PCDFs	1.0	1.1

Table B.5.1.11-2 Method SW8280B Calibration and QC Procedures for Dioxins/Furans

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Mass spectrometer tune	As per Method SW8280B, Section 11.13.	As per Method SW8280B, Section 11.13.	Retune instrument; verify.
Initial and continuing calibration	As per Method SW8280B, Section 11.13.	As per Method SW8280B, Section 11.13.	Correct problem then repeat calibration.
Identification/ retention times/ ion ratios/signal to noise/ interferences	As per Method SW8280B, Section 11.14.	As per Method SW8280B, Section 11.14.	As per Method SW8280B Section 9.7. ^b
System performance check	As per Method SW8280B, Section 11.12.	As per Method SW8280B, Section 11.12.	Correct problem and rerun.
Quality control checks except MS/MSD	As per Method SW8280B, Section 9.6, as clarified in Element B.5.1.11 of this QAPP.	As per Method SW8280B, Section 9.6.	Correct problem and rerun.
MS/Duplicate	One MS/Duplicate per every project samples per matrix.	QC acceptance criteria, Method SW8280B.	Describe in LRC.
Internal standard	As per Method SW8280B.	As per Method SW8280B.	Correct problem and rerun.
MDL study	As per Element B.5.1.11 of this QAPP.	As per Element B.5.1.11 of this QAPP.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory
- b. In accordance with SW8280B, peaks that fail to meet identification criteria are reported as non-detects at the sample- and analyte-specific estimated quantitation

B.5.1.12 *Method SW8290A-Polychlorinated Dibenzo-p-Dioxins
and Polychlorinated Dibenzofurans*

Method SW8290A is used to analyze for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in water, sediment, soil, and waste. This GC/mass spectrometry method uses matrix-specific extraction, analyte-specific cleanup, and high-resolution capillary column GC/high resolution mass spectrometry techniques to separate and identify the analytes of interest. The sensitivity of the method is dependent on the level of matrix interference. Selected cleanup methods may be used to reduce or eliminate interferences. Target analytes may include all congener classes, tetra- through octa-dioxins and furans. Achieved detection limits vary according to matrix and analyte. Because of the extreme toxicity of these compounds, the analyst must take appropriate precautions during preparation and analysis to prevent accidental exposure.

Isomer specificity for all congeners cannot be achieved using the recommended GC column and conditions in Method SW8290A. If a congener is not resolvable from other congeners during calibration or column performance check analyses and is identified as detectable on the primary column in a given sample analysis, then its presence and concentration shall be determined on another GC column that resolves the given congener.

Method SW8290A provides for sample- and analyte-specific EQL calculations based on measured signal to noise ratios. The numeric value associated with a non-detectable result shall be the EQL calculated as specified in the analytical method (depending on the type of response produced during analysis of a given sample), rather than the MDL.

In addition, a quantitation limit determination for each 2,3,7,8-substituted congener using the following procedure shall be substituted for the MDL determination and comparison to method quantitation limits specified in this QAPP.

Seven method blanks shall be analyzed within a seven consecutive day period during the 12 months preceding the analysis of samples within a given batch. It is acceptable for sample and standard analyses to be interspersed amongst these method blanks, but no additional method blank analyses shall be interspersed among the seven method blanks to be used for the quantitation limit evaluation. The maximum reported value (EQL for non-detects) shall be less than or equal to the MQL specified in Table B.5.1.12-1 and the mean of the reported values (EQL for non-detects) shall be less than or equal to one half of the MQL specified in Table B.5.1.12-1.

Method SW8290A specifies several quality control samples that are optional. For analyses under this QAPP, the following QC samples will be utilized:

- Performance check solutions and GC column performance check samples will be analyzed in accordance with the method.

- No fortified field blank will be required
- MS/MSD samples will be analyzed at the frequency specified in the method.
- Laboratory duplicate sample analyses will not be required.
- Field duplicate analyses will be conducted at the frequency specified in Section 4 of the FSP.

Table B.5.1.12-1 Method SW8290A MQLs for Dioxins/Furans

Analyte ^a , CAS No.	Water MQL (ng/L)	Soil MQL (ng/kg)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD), 1746-01-6	0.01	1.0
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD), 40321-76-4	0.01	1.0
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD), 57653-85-	0.025	2.5
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD), 39227-28-	0.025	2.5
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD), 19408-74-	0.025	2.5
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD), 35822-	0.025	2.5
1,2,3,4,5,6,7,8-Octachlorodibenzo-p-dioxin (OCDD), 3268-	0.05	5.0
2,3,7,8-Tetrachlorodibenzofuran (TCDF), 51207-31-9	0.01	1.0
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF), 57117-41-6	0.01	1.0
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF), 57117-31-4	0.05	1.0
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF), 57117-44-9	0.025	2.5
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF), 72918-21-9	0.025	2.5
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF), 70648-26-9	0.025	2.5
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF), 60851-34-5	0.025	2.5
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF), 67562-39-4	0.025	2.5
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF), 55673-89-7	0.025	2.5
1,2,3,4,5,6,7,8-Octachlorodibenzofuran (OCDF), 39001-02-0	0.05	5.0

- a. Total concentrations in a homologous series shall be calculated in accordance with Method SW8290A Section 7.9.4 and shall include concentrations of 2,3,7,8-substituted congeners even though they are separately reported elsewhere on the data reporting form. The method quantitation limit requirement is based on the quantitation limit attainable on individual congeners within a homologous series.

Table B.5.1.12-2 Method SW8290A Calibration and QC Procedures for Dioxins/Furans

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Mass spectrometer tune.	As per Method SW8290A, Section 11.6.2.	As per Method SW8290A, Section 11.6.2.	Retune instrument; verify.
Initial and continuing calibration.	As per Method SW8290A, Section 11.7.	As per Method SW8290A, Section 11.7.	Correct problem then repeat calibration.
Identification/ retention times/ ion ratios/signal to noise/ interferences.	As per Method SW8290A, Section 11.8.4.	As per Method SW8290A, Section 11.8.4.	As per Method SW8290A Section 9.8. ^b
System performance check.	As per Method SW8290A, Section 9.3.	As per Method SW8290A, Section 9.3.	Correct problem and rerun.
Quality control checks except MS/MSD.	As per Method SW8290A, Section 9.6.	As per Method SW8290A, Section 9.6.	Correct problem and rerun.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Method SW8290A, Section 9.6.5.	Describe in LRC.
Internal standard.	As per Method SW8290A, Section 9.7.	As per Method SW8290A, Section 9.7.	Correct problem and rerun.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory
- b. In accordance with SW8290A, peaks that fail to meet identification criteria are reported as non-detects at the sample- and analyte-specific estimated quantitation limit.

B.5.1.13 *Method SW8310–Polynuclear Aromatic Hydrocarbons*

Method SW8310 is used to determine the concentration of selected polynuclear aromatic hydrocarbons (PAHs) in groundwater and soils by high-performance liquid chromatography (HPLC). Samples are extracted then analyzed by direct injection. Detection is by ultraviolet and fluorescence detectors.

Table B.5.1.13-1 Method SW8310 MQLs for Polynuclear Aromatic Hydrocarbons

Analyte, CAS No.	Water MQL (ug/L)	Soil MQL (mg/kg)
Acenaphthene, 83-32-9	1.0	0.2
Acenaphthylene, 208-96-8	1.0	0.1
Anthracene, 120-12-7	1.0	0.1
Benzo(a)anthracene, 56-55-3	0.1	0.01
Benzo(a)pyrene, 50-32-8	0.2	0.015
Benzo(b)fluoranthene, 205-99-2	0.2	0.01
Benzo(g,h,i)perylene, 191-24-2	0.5	0.05
Benzo(k)fluoranthene, 207-08-9	0.2	0.01
Chrysene, 218-01-9	0.5	0.1
Dibenzo(a,h)anthracene, 53-70-3	0.2	0.01
Fluoranthrene, 206-44-0	1.0	0.1
Fluorene, 86-73-7	2.0	0.2
Indeno(1,2,3-c,d)pyrene, 193-39-5	0.2	0.03
Naphthalene, 91-20-3	1.0	0.2
Phenanthrene, 85-01-8	1.0	0.1
Pyrene, 129-00-0	1.0	0.1

Table B.5.1.13-2 Method SW8310 QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Acenaphthene	37-128	≤ 30	37-128	≤ 50
Acenaphthylene	40-121	≤ 30	40-121	≤ 50
Anthracene	41-120	≤ 30	47-125	≤ 50
Benzo(a)anthracene	49-120	≤ 30	50-120	≤ 50
Benzo(a)pyrene	45-120	≤ 30	40-133	≤ 50
Benzo(b)fluoranthene	51-120	≤ 30	57-121	≤ 50
Benzo(g,h,i)perylene	34-120	≤ 30	53-120	≤ 50
Benzo(k)fluoranthene	48-120	≤ 30	48-121	≤ 50
Chrysene	50-120	≤ 30	55-120	≤ 50
Dibenzo(a,h)anthracene	33-120	≤ 30	47-120	≤ 50
Fluoranthene	48-120	≤ 30	43-129	≤ 50
Fluorene	42-128	≤ 30	46-120	≤ 50
Indeno(1,2,3-c,d)pyrene	47-120	≤ 30	56-134	≤ 50
Naphthalene	33-120	≤ 30	48-120	≤ 50
Phenathrene	40-120	≤ 30	57-126	≤ 50
Pyrene	52-120	≤ 30	49-120	≤ 50
Surrogates:				
Terphenyl-D14	25-157		22-167	
Decafluorobiphenyl	33-141		37-152	

Table B.5.1.13-3 Method SW8310 Calibration and QC Procedures for PAHs

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	linear – Analyte RSD \leq 20%. linear – least squares regression $r \geq 0.995$ for each analyte. non-linear – COD ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	± 3 times standard deviation for each analyte average retention time from 72-hour study.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.13-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.13-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.13-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.13-2.	Describe in LRC.
Confirmation ^b	100% for all positive results.	Same as for initial or primary analysis. RPD for dual column results \leq 40%.	Describe in LRC. If no chromatographic anomalies or problems noted, report the lower result as per Section 11.10.4.2 of Method 8000C.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.13-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

b. Use a second column or different detector.

B.5.1.14 *Method SW8330B—Explosive Residues*

Method SW8330B provides HPLC conditions for the detection and low level quantitation of certain explosive residues in a water, soil, and sediment matrix. Prior to using this method, appropriate sample preparation techniques must be used.

In the low-level, salting-out method with no evaporation, aqueous samples of low concentration are extracted by a salting-out extraction procedure. An aliquot of the extract is separated on a primary reversed-phase column, determined at 254 nm and 210 nm, and confirmed on a second reversed-phase column that provides a different order of analyte elution.

In the high-level direct injection method, aqueous samples of higher concentration can be diluted, filtered, separated on a primary reversed-phase column, determined at 254 nm and 210 nm, and confirmed on a reversed-phase confirmation column.

Soil and sediment samples are extracted in an ultrasonic bath and filtered before chromatography.

Table B.5.1.14-1 Method SW8330B MQLs for Explosive Residues

Analyte, CAS No.	Water MQL (ug/L)	Soil MQL (mg/kg)
1,3,5-Trinitrobenzene, 99-35-4	1.0	0.25
1,3-Dinitrobenzene, 99-65-0	1.0	0.25
2,4,6-Trinitrotoluene, 118-96-7	1.0	0.25
2,4-Dinitrotoluene, 121-14-2	1.0	0.25
2,6-Dinitrotoluene, 606-20-2	1.0	0.26
HMX, 2691-41-0	1.0	2.2
m-Nitrotoluene, 99-08-1	1.0	0.25
Methyl-2,4,6-trinitrophenylnitramine, 479-45-8	1.0	0.65
Nitrobenzene, 98-95-3	1.0	0.26
o-Nitrotoluene, 88-72-2	1.0	0.25
p-Nitrotoluene, 99-99-0	1.0	0.25
RDX, 121-82-4	1.0	1.0

Table B.5.1.14-2 Method SW8330B QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
1,3,5-Trinitrobenzene	64-139	≤ 30	54-136	≤ 50
1,3-Dinitrobenzene	47-158	≤ 30	79-124	≤ 50
2,4,6-Trinitrotoluene	52-143	≤ 30	55-142	≤ 50
2,4-Dinitrotoluene	61-135	≤ 30	56-141	≤ 50
2,6-Dinitrotoluene	60-137	≤ 30	77-122	≤ 50
HMX	51-161	≤ 30	72-134	≤ 50
m-Nitrotoluene	48-132	≤ 30	52-133	≤ 50
Methyl-2,4,6-Trinitrophenylnitramine	22-174	≤ 30	25-142	≤ 50
Nitrobenzene	49-138	≤ 30	49-154	≤ 50
o-Nitrotoluene	43-133	≤ 30	59-136	≤ 50
p-Nitrotoluene	48-132	≤ 30	77-124	≤ 50
RDX	81-120	≤ 30	74-126	≤ 50
<i>Surrogates</i>				
3,4-Dinitrotoluene	60-135		55-140	
1,2-Dinitrobenzene	45-160		80-125	

Table B.5.1.14-3 Method SW8330B Calibration and QC Procedures for Explosive Residues

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Five-point initial calibration for all analytes.	Initial calibration prior to sample analysis.	RSD for all analytes $\leq 20\%$. linear – least squares regression $r \geq 0.995$ for each analyte. non-linear – COD ≥ 0.990 second order uses 6 points; third order uses 7 points	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per five-point initial calibration.	All analytes within $\pm 30\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	± 3 times standard deviation for each analyte average retention time from 72-hour study.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.14-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.14-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Surrogate spike.	Every sample, spiked sample, standard, and method blank.	QC acceptance criteria, Table B.5.1.14-2.	Method 8000C, Section 9.6 Requirements. Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.14-2.	Describe in LRC.
Confirmation ^b	100% for all positive results.	Same as for initial or primary analysis. RPD for the dual column results $\leq 40\%$.	Describe in LRC. If no chromatographic anomalies or problems noted, report the lower result as per Section 11.10.4.2 of Method 8000C.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.14-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.
- b. Use a second column or different detector.

B.5.1.15 *Method SW6010D-Trace Elements (Metals) by Inductively Coupled Plasma Optical Emission Spectroscopy for Water and Soil*

Samples are analyzed for trace elements or metals using Method SW6010D for water and soils. Analysis for most metals requires digestion of the sample. Following digestion, the trace elements are determined simultaneously or sequentially using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). The elements and corresponding MQLs for this method are listed in Table B.5.1.15-1.

Table B.5.1.15-1 Method SW6010D MQLs for Metals by ICP-OES

Analyte, CAS No.	Water MQL (mg/L)	Soil MQL (mg/kg)
Aluminum, 7429-90-5	0.2	20
Antimony, 7440-36-0	0.05	10.0
Arsenic, 7440-38-2	0.03	5.0
Barium, 7440-39-3	0.05	1.0
Beryllium, 7440-41-7	0.004	1.0
Cadmium, 7440-43-9	0.005	0.50
Calcium, 7440-70-2	1.1	100
Chromium, 7440-47-3	0.01	1.0
Cobalt, 7440-48-4	0.06	1.0
Copper, 7440-50-8	0.01	2.0
Iron, 7439-89-6	0.2	3.0
Lead, 7439-92-1	0.025	3.0
Magnesium, 7439-95-4	1.0	100
Manganese, 7439-96-5	0.01	1.0
Molybdenum, 7439-98-7	0.015	3.0
Nickel, 7440-02-0	0.02	2.0
Potassium, 7440-09-7	1.0	200
Selenium, 7782-49-2	0.03	3.0
Silver, 7440-22-4	0.01	1.0
Sodium, 7440-23-5	1.0	100
Thallium, 7440-28-0	0.08	6.0
Vanadium, 7440-62-2	0.01	1.0
Zinc, 7440-66-6	0.02	2.0

Table B.5.1.15-2 Method SW6010D QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Aluminum	80-120	≤ 20	80-120	≤ 30
Antimony	80-120	≤ 20	80-120	≤ 30
Arsenic	80-120	≤ 20	80-120	≤ 30
Barium	80-120	≤ 20	80-120	≤ 30
Beryllium	80-120	≤ 20	80-120	≤ 30
Cadmium	80-120	≤ 20	80-120	≤ 30
Calcium	80-120	≤ 20	80-120	≤ 30
Chromium	80-120	≤ 20	80-120	≤ 30
Cobalt	80-120	≤ 20	80-120	≤ 30
Copper	80-120	≤ 20	80-120	≤ 30
Iron	80-120	≤ 20	80-120	≤ 30
Lead	80-120	≤ 20	80-120	≤ 30
Magnesium	80-120	≤ 20	80-120	≤ 30
Manganese	80-120	≤ 20	80-120	≤ 30
Molybdenum	80-120	≤ 20	80-120	≤ 30
Nickel	80-120	≤ 20	80-120	≤ 30
Potassium	80-120	≤ 20	80-120	≤ 30
Selenium	80-120	≤ 20	80-120	≤ 30
Silver	80-120	≤ 20	80-120	≤ 30
Sodium	80-120	≤ 20	80-120	≤ 30
Thallium	80-120	≤ 20	80-120	≤ 30
Vanadium	80-120	≤ 20	80-120	≤ 30
Zinc	80-120	≤ 20	80-120	≤ 30

Table B.5.1.15-3 Method SW6010D Calibration and QC Procedures for ICP-OES Metals

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Initial calibration (minimum 1 standard and a blank).	Daily initial calibration prior to sample analysis.	If more than one standard is used, correlation coefficient must be ≥ 0.998 .	If applicable, correct problem and repeat initial calibration.
Mid-range initial calibration verification (second source).	Daily after initial calibration.	All analytes within $\pm 10\%$ of true value.	Correct problem then repeat initial calibration.
Calibration blank.	Before beginning a sample run, after every 10 samples and at the end of the analysis sequence.	No analytes detected \geq MQL.	Correct problem then analyze calibration blank and previous 10 samples.
Mid-range continuing calibration verification (instrument check standard).	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 10\%$ of true value.	Repeat calibration and reanalyze all samples since last successful calibration.
Low-level initial calibration verification.	Daily after initial calibration.	All analytes within $\pm 30\%$ of true value.	Correct problem then repeat initial calibration.
Low-level continuing calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 30\%$ of true value.	Repeat calibration and reanalyze all samples since last successful calibration.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
Spectral interference check solution (SIC) prepared at concentrations similar to major components in project samples).	At the beginning of an analytical run.	SIC-A Non-spiked analytes < MQL; spiked analytes within $\pm 20\%$ of true value. SIC-AB Spiked analytes within $\pm 20\%$ of true value.	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples.
LCS for the analyte.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.15-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Dilution test.	One per preparation batch.	1:5 dilution must agree within $\pm 10\%$ of the original determination for analyte concentration minimally a factor of 10 above the lower limit of quantitation after dilution.	Perform post digestion spike addition.
Post digestion spike addition.	One per preparation batch.	Recovery within 80-120% of known value.	Dilute the sample; reanalyze post digestion spike addition.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	Recovery within 75-125% of expected results.	Describe in LRC. For nonstandard methods, sample matrices, or other unusual situations, appropriate method validation study information is required to confirm performance of the method for the particular matrix. The purpose of validation information is to assess potential impact on representativeness of the data generated.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.15-1.	If MDL study does not meet acceptance criteria, repeat the study.

a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.16 *Method SW6020B-Trace Elements (Metals) by Inductively Coupled Plasma Mass Spectroscopy for Water and Soil*

Samples are analyzed for trace elements or metals using Method SW6020B for water and soils. Analysis for total (i.e., acid leachable) metals requires digestion of the sample. Following digestion, the trace elements are determined simultaneously or sequentially using Inductively Coupled Plasma Mass Spectroscopy (ICP-Mass Spec). The elements and MQLs for this method are listed in Table B.5.1.16-1.

Table B.5.1.16-1 Method SW6020B MQLs for Metals by ICP-Mass Spec

Analyte, CAS No.	Water MQL (mg/L)	Soil MQL (mg/kg)
Aluminum, 7429-90-5	0.02	2.0
Antimony, 7440-36-0	0.001	0.10
Arsenic, 7440-38-2	0.01	1.0
Barium, 7440-39-3	0.003	0.30
Beryllium, 7440-41-7	0.003	0.30
Cadmium, 7440-43-9	0.002	0.20
Chromium, 7440-47-3	0.004	0.40
Cobalt, 7440-48-4	0.008	0.80
Copper, 7440-50-8	0.006	0.60
Lead, 7439-92-1	0.002	0.20
Manganese, 7439-96-5	0.002	0.20
Mercury, 7439-97-6	0.001	0.10
Nickel, 7440-02-0	0.002	0.20
Selenium, 7782-49-2	0.001	0.10
Silver, 7440-22-4	0.002	0.20
Thallium, 7440-28-0	0.001	0.10
Zinc, 7440-66-6	0.025	2.5

Table B.5.1.16-2 Method SW6020B QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Aluminum	80-120	≤ 15	80-120	≤ 25
Antimony	80-120	≤ 15	80-120	≤ 25
Arsenic	80-120	≤ 15	80-120	≤ 25
Barium	80-120	≤ 15	80-120	≤ 25
Beryllium	80-120	≤ 15	80-120	≤ 25
Cadmium	80-120	≤ 15	80-120	≤ 25
Chromium	80-120	≤ 15	80-120	≤ 25
Cobalt	80-120	≤ 15	80-120	≤ 25
Copper	80-120	≤ 15	80-120	≤ 25
Lead	80-120	≤ 15	80-120	≤ 25
Manganese	80-120	≤ 15	80-120	≤ 25
Mercury	80-120	≤ 15	80-120	≤ 25
Nickel	80-120	≤ 15	80-120	≤ 25
Selenium	80-120	≤ 15	80-120	≤ 25
Silver	80-120	≤ 15	80-120	≤ 25
Thallium	80-120	≤ 15	80-120	≤ 25
Zinc	80-120	≤ 15	80-120	≤ 25

Table B.5.1.16-3 Method SW6020B Calibration and QC Procedures for ICP-Mass Spec Metals

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
MS tuning sample.	Prior to initial calibration and calibration verification.	SW6020A paragraph 7.10.	Retune instrument then reanalyze tuning solution.
Initial calibration (minimum 1 standard and a blank).	Daily initial calibration prior to sample analysis.	If more than one standard is used, correlation coefficient must be ≥ 0.998 .	If applicable, correct problem and repeat initial calibration.
Mid-range initial calibration verification (second source).	Daily after initial calibration.	All analytes within $\pm 10\%$ of true value.	Correct problem and repeat initial calibration.
Calibration blank.	Before beginning a sample run, after every 10 samples and at end of the analysis sequence.	No analytes detected \geq MQL.	Correct problem then analyze calibration blank and previous 10 samples.
Mid-range continuing calibration verification (instrument check standard).	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 10\%$ of true value.	Correct problem then repeat calibration and reanalyze all samples since last successful calibration.
Low-level initial calibration verification.	Daily after initial calibration.	All analytes within $\pm 30\%$ of true value.	Correct problem and repeat initial calibration.
Low-level continuing calibration verification.	After every 10 samples and at the end of the analysis sequence.	All analytes within $\pm 30\%$ of true value.	Correct problem then repeat calibration and reanalyze all samples since last successful calibration.
Method blank.	One per preparation batch	No analytes detected \geq MQL.	Correct problems reprep and analyze method blank and all samples processed with the contaminated blank.
Spectral interference check solutions (SIC-A and SIC-AB) (modified by adding major matrix components to the solutions at concentrations comparable to those in the project samples to verify correction for interferences per Section 9.7 of the method).	At the beginning of an analytical run or once during a 12-hour period, whichever is more frequent	SIC-A All non-spiked analytes < MQL unless verified as a trace impurity from one of the spiked analytes. SIC-AB Within $\pm 20\%$ of true value.	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all affected samples.
LCS for the analyte.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.16-2.	Correct problem reprep and analyze the LCS and all samples in the affected analytical batch.
Dilution test.	One per preparation batch.	1:5 dilution must agree within $\pm 10\%$ of the original determination for analyte concentration minimally 10X above the lower limit of quantitation after dilution.	Perform post digestion spike addition for failed analytes.
Post digestion spike addition.	One per preparation batch.	Recovery within 80-120% of known value.	Dilute the sample; reanalyze post digestion spike addition.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	Recovery within 75-125% of expected results.	Describe in LRC.
Internal standards.	Every sample.	IS intensity $\geq 70\%$ of the intensity of the IS in the initial calibration standard.	Perform corrective action as described in Method SW6020A, Section 9.6.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.16-1.	If the MDL study does not meet acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.17 *Method SW7196A-Hexavalent Chromium (Colorimetric)*

Dissolved hexavalent chromium, in the absence of interfering amounts of substances such as molybdenum, vanadium, and mercury, may be determined colorimetrically. MQLs for this method are listed in Table B.5.1.17-1. Hexavalent chromium analyses conducted on soil or sediment samples must be extracted using Method SW3060A.

Table B.5.1.17-1 Method SW7196A MQLs for Hexavalent Chromium

Analyte, CAS No.	Water MQL (mg/L)	Soil MQL (mg/kg)
Hexavalent Chromium, 18540-29-9	0.05	1.0

Table B.5.1.17-2 Method SW7196A QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Hexavalent Chromium	86-117	≤ 15	86-117	≤ 30

Table B.5.1.17-3 Method SW7196A Calibration and QC Procedures for Hexavalent Chromium

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Multipoint calibration curve (minimum three standards and a blank).	Initial calibration prior to sample analysis.	Correlation coefficient \geq 0.995 for linear regression.	Correct problem then repeat initial calibration.
Second-source calibration verification.	After each new stock standard preparation.	Analytes within $\pm 10\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 15 samples and at the end of the analysis sequence.	Chromium within $\pm 20\%$ of expected value.	Correct problem then repeat initial calibration and reanalyze all samples since last successful calibration.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.17-2.	Recalculate results; locate and fix problem with system and then rerun demonstration.
Verification check to ensure lack of reducing condition and/or interference.	Once for every sample matrix analyzed.	Spike recovery between 85-115%.	If check indicates interference, dilute and reanalyze sample. Persistent interference indicates the need to use an alternate method.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.17-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.17-2.	Describe in LRC.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.17-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.18 *Method SW7470A/SW7471B–Mercury Manual Cold-Vapor Technique*

Water and soil samples are analyzed for mercury using Methods SW7470A and SW7471B, respectively. This method is a cold-vapor, flameless atomic absorption (AA) technique based on the absorption of radiation by mercury vapor. Mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an AA spectrophotometer. Mercury concentration is measured as a function of absorbance. The MQLs for these methods are listed in Table B.5.1.18-1.

Table B.5.1.18-1 Method SW7470A(W)/SW7471B(S) MQLs for Mercury

Analyte, CAS No.	Water MQL (mg/L)	Soil MQL (mg/kg)
Mercury, 7439-97-6	0.001	0.1

Table B.5.1.18-2 Method SW7470A/SW7471B QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Mercury	85–115	≤ 15	83–118	≤ 30

Table B.5.1.18-3 Method SW7470A/SW7471B Calibration and QC Procedures for Mercury

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Initial multipoint calibration (minimum 5 standards and a blank).	Daily initial calibration prior to sample analysis.	Correlation coefficient \geq 0.995 for linear or non-linear regression.	Correct problem then repeat initial calibration.
Second-source calibration check standard.	Once per initial daily multipoint calibration.	Analyte within $\pm 10\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration blank.	Once per initial daily multipoint calibration.	No analyte detected \geq MQL.	Correct problem then reanalyze calibration blank and all samples associated with blank.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	The analyte within $\pm 10\%$ of expected value.	Correct problem then repeat calibration and reanalyze all samples since last successful calibration.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.18-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for the analyte.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.18-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Recovery test.	When MS/MSD fails.	Recovery within 85-115% of expected results.	Run all samples by the method of standard additions.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.18-2.	Describe in LRC.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.18-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.19 *Method SW9010C/SW9012B-Total Cyanide and Cyanide Amenable to Chlorination*

Water and waste samples are analyzed for total cyanide using Method SW9010C or SW9012B. These methods are equivalent in principle of analysis; SW9010C is a manual procedure, and SW9012B is an automated procedure.

Both methods are used to determine the concentration of inorganic cyanide in wastes and leachates. The methods detect inorganic cyanides that are present as either soluble cyanide salts or insoluble cyanide complexes. The methods are used to determine values for both total cyanide and cyanide amenable to chlorination. The cyanide is released by refluxing the sample with a strong acid and catalyst and distillation. Total cyanide in soils is determined after acidification of the soil and distillation. The cyanide ion in the absorbing solution is then determined by spectrophotometry for Method SW9010C and by automated UV colorimetry for Method SW9012B. The MQLs for cyanide are listed in B.5.1.19-1.

Table B.5.1.19-1 Method SW9010C/SW9012B MQLs

Analyte, CAS No.	Water MQL (mg/L)	Soil MQL (mg/kg)
Total Cyanide, 57-12-5	0.02	0.5

Table B.5.1.19-2 Method SW9010C/SW9012B QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Total Cyanide	79-114	≤ 20	75-125	≤ 30

Table B.5.1.19-3 Method SW9010C/SW9012B Calibration and QC Procedures for Total Cyanide

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Multipoint calibration curve (six standards and a calibration blank).	Initial daily calibration prior to sample analysis.	Correlation coefficient \geq 0.995 for linear regression.	Correct problem then repeat initial calibration.
Distilled standards (one high and one low).	Once per multipoint calibration.	Cyanide within $\pm 10\%$ of true value.	Correct problem then repeat distilled standards.
Second-source calibration verification.	Once per stock standard preparation.	Cyanide within $\pm 15\%$ of expected value.	Correct problem then repeat initial calibration.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.19-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.19-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.19-2.	Describe in LRC.
MDL study.	Once per 12 month period.	Detection limits established shall be \leq $\frac{1}{2}$ the MQLs in Table B.5.1.19-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.20 *Method SW9056A—Common Anions*

This method addresses the sequential determination of the anions chloride, fluoride, bromide, nitrate, nitrite, phosphate, and sulfate in the collection solutions from the bomb combustion of solid waste samples, as well as water samples.

A small volume of combustate collection solution or other water sample is injected into an ion chromatograph to flush and fill a constant volume sample loop. The sample is then injected into a stream of eluent.

The sample is pumped through three different ion exchange columns and into a conductivity detector. The first two columns, a precolumn (guard) column and a separator column, are packed with a low-capacity, strongly basic anion exchanger. Ions are separated into discrete bands based on their affinity for the exchange sites of the resin. The last column is a suppressor column that reduces the anions in the sample to their corresponding acids. The separated anions in their acid form are measured using an electrical-conductivity cell. Anions are identified based on their retention times compared to known standards. Quantitation is accomplished by measuring the peak height or area and comparing it to a calibration curve generated from known standards.

Table B.5.1.20-1 Method SW9056A MQLs for Common Anions

Analyte, CAS No.	Water MQL (mg/L)	Soil MQL (mg/kg)
Bromide, 24959-67-9	0.5	5.0
Chloride, 16887-00-6	1.0	10
Fluoride, 16984-48-8	1.0	10
Nitrate, 14797-55-8	1.0	10
Nitrite, 14797-65-0	1.0	10
Phosphate, 14265-44-2	1.0	10
Sulfate, 14808-79-8	1.0	10

Table B.5.1.20-2 Method SW9056A QC Acceptance Criteria

Analyte	Accuracy Water (% R)	Precision Water (RPD)	Accuracy Soil (% R)	Precision Soil (RPD)
Bromide	85–115	≤ 20	70–130	≤ 30
Chloride	85–115	≤ 20	70–130	≤ 30
Fluoride	85–115	≤ 20	70–130	≤ 30
Nitrate	85–115	≤ 20	70–130	≤ 30
Nitrite	85–115	≤ 20	70–130	≤ 30
Phosphate	85–115	≤ 20	70–130	≤ 30
Sulfate	85–115	≤ 20	70–130	≤ 30

Table B.5.1.20-3 Method SW9056A Calibration and QC Procedures for Common Anions

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Multipoint calibration for all analytes (minimum 3 standards and one calibration blank).	Initial calibration prior to sample analysis.	Correlation coefficient \geq 0.995 for linear or non-linear regression.	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per multipoint calibration.	All analytes within $\pm 10\%$ of expected value.	Correct problem then repeat initial calibration.
Retention time window calculated for each analyte.	Each initial calibration and calibration verifications.	± 3 times standard deviation for each analyte average retention time over 8 hour period.	Correct problem then reanalyze all samples analyzed since the last retention time check.
Initial calibration verification.	Daily, before sample analysis or when eluent is changed.	All analytes within $\pm 10\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification.	After every 10 samples and at the end of the analysis sequence.	Instrument response within $\pm 10\%$ of expected response.	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.20-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Method blank.	One per preparation batch.	No analytes detected \geq MQL.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.20-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
Duplicate.	One per every 10 samples.	RPD $\leq 10\%$.	Describe in LRC.
MS/MSD.	One MS/MSD per every 20 project samples per matrix.	QC acceptance criteria, Table B.5.1.20-2.	Describe in LRC.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.20-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.1.21 *Method TO-15 - Volatile Organics in Ambient Air*

Volatile organics in air are sampled using a Summa canister and analyzed using EPA Compendium Method TO-15. This method uses a high resolution GC coupled to one or more appropriate detectors. The QC criteria specified herein are pertinent to using a mass spectrometer in scan or SIM mode as the detector. The analytes detected and MOLs for this method are listed in Table B.5.1.21-1.

Calibration—The mass spectrometer is tuned daily to give an acceptable spectrum for BFB. The tuning acceptance criteria are given in the following list as the ion abundance for each specified mass:

- mass 50 8 percent to 40 percent of mass 95
- mass 75 30 percent to 66 percent of mass 95
- mass 95 base peak, 100 percent relative abundance
- mass 96 5 percent to 9 percent of mass 95
- mass 173 less than 2 percent of mass 174
- mass 174 50 percent to 120 percent of mass 95
- mass 175 4 percent to 9 percent of mass 174
- mass 176 93 percent to 101 percent of mass 174
- mass 177 5 percent to 9 percent of mass 176

The internal standard method is used for quantitation of analytes of interest. For quantitation, response factors are calculated from the base ion peak of a specific internal standard added to each calibration standard, blank, QC sample, and sample.

Table B.5.1.21-1 Method TO-15 MQLs for Volatile Organics

Analyte ^a , CAS No.	Air MQL (ppbv)
1,1,1-Trichloroethane, 71-55-6	0.8
1,2-Dichloroethane, 107-06-2	0.6
1,2-Dibromoethane, 106-93-4	0.6
Benzene, 71-43-2	0.4
Carbon tetrachloride, 56-23-5	2.1
Chloroform, 67-66-3	0.3
m-Xylene, 108-38-3	0.5
o-Xylene, 95-47-6	1.1
p-Xylene, 106-42-3	1.3
Styrene, 100-42-5	0.4
Tetrachloroethene, 127-18-4	0.8
Trichloroethene, 79-01-6	1.0
Vinyl chloride, 75-01-4	1.0

a = Other compounds may be analyzed using TO-15 if specified as a QAPP addition under Section 6 of the site-specific FSP. The QAPP addition should also specify holding times pertinent to additional analytes.

Table B.5.1.21-2 Method TO-15 QC Acceptance Criteria

Analyte	Accuracy Air (% R)	Precision Air (RPD)
1,1,1-Trichloroethane	72-125	≤ 20
1,2-Dichloroethane	75-125	≤ 20
1,2-Dibromoethane	74-125	≤ 20
Benzene	75-127	≤ 20
Carbon tetrachloride	72-125	≤ 20
Chloroform	75-125	≤ 20
m-Xylene	75-125	≤ 20
o-Xylene	75-137	≤ 20
p-Xylene	75-125	≤ 20
Styrene	75-135	≤ 20
Tetrachloroethene	75-125	≤ 20
Trichloroethene	75-125	≤ 20
Vinyl chloride	75-125	≤ 20

Table B.5.1.21-3 Method TO-15 Calibration and QC Procedures for Volatile Organics

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Initial multipoint calibration (minimum 5 standards prepared in humidified zero air).	Initial calibration prior to sample analysis.	%RSD for all calibration analytes $\leq 30\%$.	Correct problem then repeat initial calibration.
Second-source calibration verification.	Once per three-point initial calibration.	All analytes within $\pm 30\%$ of expected value.	Correct problem then repeat initial calibration.
Calibration verification (one point).	Daily, before sample analysis and every 24 hours of analysis time.	All calibration analytes within $\pm 30\%$ of expected value.	Correct problem then repeat initial calibration.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample.	Once per analyst.	QC acceptance criteria, Table B.5.1.21-2.	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.
Check of mass spectral ion intensities using BFB.	Prior to initial calibration and calibration verification.	Refer to criteria in Element B.5.1.21 text.	Retune instrument and verify.
Internal standards.	Immediately after or during data acquisition for the calibration verification standard.	Retention time ± 20 seconds from retention time of the mid-point std. in the ICAL. Area response within $\pm 40\%$ of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.
Method blank.	One per preparation batch.	No analytes detected $\geq \text{MQL}$.	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes.	One LCS per preparation batch.	QC acceptance criteria, Table B.5.1.21-2.	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch.
MDL study.	Once per 12 month period.	Detection limits established shall be $\leq \frac{1}{2}$ the MQLs in Table B.5.1.21-1.	If the MDL study does not meet the acceptance criteria, repeat the MDL study.

- a. All corrective actions associated with project work shall be documented, and all records shall be maintained by the laboratory.

B.5.2 Screening Methods

Table B.5.2-1 presents the calibration, QC, and corrective action procedures for each screening method.

Table B.5.2-1 Calibration, QC, and Corrective Action Procedures for Screening Methods

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
Described in Method SW3550	Moisture.	Laboratory Duplicate sample.	1 per 20 samples.	% solid RPD \leq 15%.	Correct problem, repeat measurement. If still out, flag data.
SW9045D	pH (soil and waste).	2-point calibration with pH buffers.	1 per 10 samples analyzed.	\pm 0.05 pH unit.	Check with new buffers; if still out, repair meter; repeat calibration check.
		pH 7 buffer.	At each sample location.	\pm 0.1 pH unit.	Recalibrate.
		Duplicate sample.	10% of field samples.	\pm 0.1 pH unit.	Correct problem, repeat measurement. If still out, repeat calibration and reanalyze samples.
SW9050A	Conductance.	Calibration with KCl standard.	Once per day at beginning of testing.	\pm 5%.	If calibration is not achieved, check meter, standards, and probe; recalibrate.
		Field duplicate.	10% of field samples.	\pm 5%.	Correct problem, repeat measurement.
SW9040C	pH (water).	2-point calibration with pH buffers.	Once per day.	\pm 0.05 pH units for every buffer.	If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary; repeat calibration.
		pH 7 buffer.	At each sample location.	\pm 0.1 pH units.	Correct problem, recalibrate.
		Field duplicate.	10% of field samples.	\pm 0.1 pH units.	Correct problem, repeat measurement.
E170.1	Temperature	Field duplicate.	10% of field samples.	\pm 1.0°C.	Correct problem, repeat measurement.
E180.1	Turbidity	Calibration with one formazin standard per instrument range used.	Once per day at beginning of testing.	\pm 5 units, 0–100 range \pm 0.5 units, 0–0.2 range \pm 0.2 units, 0–1 range	If calibration is not achieved, check meter; replace if necessary, recalibrate.
		Field duplicate.	10% of field samples.	RPD \leq 20%.	Correct problem, repeat measurement.
SW9060A	Total organic carbon	Method blank.	Daily or one per batch, whichever is more frequent.	< MQL.	Clean system; reanalyze blank. Repeat until analyte < MQL.
		Field duplicate.	10% of field samples.	RPD < 20%.	Repeat measurement.
		Laboratory duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
E160.1	Filterable residue	Field duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
		Laboratory duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a
E160.2	Nonfilterable residue	Field duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
		Laboratory duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
ASTM D1498	Oxidation-reduction potential (ORP)	Sensitivity verification.	Daily.	ORP should decrease when pH is increased.	If ORP increases, correct the polarity of electrodes. If ORP still does not decrease, clean electrodes and repeat procedure.
		Calibration with one standard.	Once per day.	Two successive readings ± 10 millivolts.	Correct problem, recalibrate.
		Field duplicate.	10% of field samples.	± 10 millivolts.	Correct problem, repeat measurement.
SW1110	Corrosivity	Laboratory Duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
E310.1	Alkalinity	Field duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
E360.1	Dissolved oxygen	Field duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
SW4020	PCBs by immunoassay	Field duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
SW4030	Petroleum hydrocarbons by immunoassay	Field duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
SW4035	PAHs by immunoassay	Field duplicate.	10% of field samples.	RPD < 20%.	Correct problem, repeat measurement.
SW6200	Metals in soils and sediments by field portable X-ray fluorescence spectrometry	Energy calibration check	At beginning of each day of instrument use.	Manufacturer specifications	Reposition pure element standard and reanalyze. If manufacturer specifications not met after repositioning, perform energy calibration.
		Calibration verification check (CVC) sample	Analyze at the beginning of each working day, during active sample analyses, and at the end of each working day.	$\pm 20\%$ true value	Reanalyze CVC. If reanalysis fails, recalibrate and reanalyze the batch of samples analyzed before the unacceptable CVC.
		Precision	Daily analyze 7 replicates of a precision sample for each analysis technique. Select precision samples with concentration near action level and at varying concentrations, e.g., high, medium & low.	<20% RSD <30% RSD for chromium	Reanalyze, recalculate the % RSD, and document the results.
		Instrument blank	Beginning and end of working day and after every 20 samples.	No metal concentrations greater than the established detection limit.	Check probe and window for contamination. If none found, zero instrument by following manufacturer specifications.
		Method Blank	Minimum once daily.	Less than the detection limit or <10% lowest sample concentration for the analyte, whichever is greater	Identify the problem, and reanalyze all samples associated with the failed method blank.

a. All corrective actions shall be documented, and the records shall be maintained by the Contractor.

B.5.3 Quality Control Measure Descriptions

The quality control parameters monitored and evaluated during Superfund projects are precision, accuracy, representativeness, completeness, and comparability. The basis for assessing each of these elements of data quality is discussed in the following sub-elements. Precision and accuracy QC limits for each method and matrix are identified in Elements B.5.1 and B.5.2 of this QAPP. Table B.5.3-1 presents the statistical calculations used in the evaluation.

Table B.5.3-1 Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Mean	\bar{x}	$\frac{\left(\sum_{i=1}^n x_i\right)}{n}$	Measure of central tendency.	Used to determine average value of measurements.
Standard Deviation	S	$\left(\frac{\sum (x_i - \bar{x})^2}{(n-1)}\right)^{1/2}$	Measure of relative scatter of the data.	Used in calculating variations of measurements.
Relative Standard Deviation	RSD	$\frac{s}{\bar{x}} \times 100$	Relative standard deviation, adjusts for magnitude of observations.	Used to assess precision for replicate results.
Relative Percent Difference	RPD	$abs\left(\frac{(x_1 - x_2)}{(x_1 + x_2)/2}\right) \times 100$	Measure of variability that adjusts for the magnitude of observations.	Used to assess total and analytical precision of duplicate measurements.
Percent Difference	%D	$\frac{x_1 - x_2}{x_2} \times 100$	Measure of the difference of two observations.	Used to assess accuracy.
Percent Recovery	%R	$\frac{x_{meas}}{x_{true}} \times 100$	Recovery of spiked compound in laboratory matrix.	Used to assess accuracy.
Percent Recovery	%R	$\frac{\left(\frac{\text{value of spiked sample} - \text{value of unspiked sample}}{\text{value of added spike}}\right)}{\text{value of added spike}} \times 100$	Recovery of spiked compound in sample matrix.	Used to assess matrix effects and total precision.

x = Observation (concentration)

n = Number of observations

B.5.3.1 *Precision*

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions (EPA QA/G-5 definition). Analytical precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. TCEQ uses the laboratory control sample (LCS) to determine the precision of the analytical method. If the recoveries of analytes in the LCS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and the control charted samples analyzed in previous batches. Total precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. The formula for calculating the RPD is provided in Table B.5.3-1. For replicate analyses, the relative standard deviation (RSD) is determined. The formula for the calculation of the RSD is in Table B.5.3-1.

B.5.3.2 *Accuracy*

Accuracy is a statistical measurement of correctness and includes components of random error (precision) and systematic error (bias) (EPA QA/G-5 definition). It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS or matrix spike sample to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed. Analysis of performance evaluation (PE) samples may also be used to provide additional information for assessing the accuracy of the analytical data being produced.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculations of accuracy are included in Table B.5.3-1 as percent recovery (%R) and percent difference (%D) from reagent grade pure matrices and sample matrices.

B.5.3.3 *Representativeness*

Representativeness is defined as a measure of the extent to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition (EPA QA/G-5 definition). Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations. Decisions regarding sample/well/ boring locations and numbers and the statistical sampling design are documented in Section 4 of the FSP.

B.5.3.4 *Completeness*

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte combination. Completeness shall be calculated in two ways: 1) the number of valid individual analyte results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set for risk assessment; and 2) the number of valid sample points divided by the number of planned sample points, expressed as a percentage, determines the completeness of the data set for remedial investigation/feasibility studies. For completeness requirements, valid results are all results not qualified with an “R” flag. The completeness requirements for the project are specified in Element A.7 of this QAPP. The formula for the calculation of analytical completeness for risk assessment is presented below:

$$\% \text{ Completeness} = \frac{\text{number of valid (i.e., non - R flagged) results}}{\text{number of possible individual analyte results}}$$

The formula for the calculation of completeness of a data set for remedial investigation and feasibility studies is presented below:

$$\% \text{ Completeness} = \frac{\text{number of valid sample points}}{\text{number of planned sample points}}$$

B.5.3.5 *Comparability*

Comparability is the confidence with which one data set can be compared to another data set (EPA QA/G-5 definition). The objective of this QA/QC program is to produce

data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Analysis of performance evaluation (PE) samples and reports from audits shall also be used to provide additional information for assessing the comparability of analytical data produced among subcontracting laboratories. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

If the collection of field split samples or samples used in intra- or inter-laboratory comparability studies is required to meet the project objectives, the QC acceptance criteria for evaluating the relative percent differences (RPDs) between the sample results shall be developed consistent with EPA Uniform Federal Policy for Quality Assurance Project Plans, Part I: UFP-QAPP Manual (EPA-505-B-04-900A) and addressed in Section 4 of the FSP.

B.5.4 Laboratory Quality Control Samples and Parameters

This element presents QC requirements relevant to analysis of environmental samples that shall be followed during all analytical activities for fixed-base, mobile, and field laboratories producing definitive data. The purpose of this QC program is to produce data of known quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for ongoing control and evaluation of data quality measurements through the use of QC materials.

Laboratory QC samples (e.g., blanks and laboratory control samples) shall be included in the preparation batch with the field samples. An analytical batch is a number of samples (not to exceed 20 environmental samples) of a similar matrix that are extracted or digested at the same time with the same lot of reagents. Field QC samples (e.g., field blanks, trip blanks, equipment blanks, field duplicates, field replicates) count as environmental samples. The term “analytical batch” also extends to cover samples that do not need separate extraction or digestion (e.g., volatile analyses by purge and trap) and is the number of samples (not to exceed 20 environmental samples) of a similar matrix analyzed sequentially. The identity of each analytical batch shall be unambiguously cross-referenced and reported with the associated sample analyses so that a reviewer can identify the QC samples and the associated environmental samples. All references to the analytical batch in the following elements and tables in this QAPP refer to the analytical batch as defined in this element.

The type of QC samples and the frequency of use of these samples are discussed below and in the method-specific sub-elements of Element B.5.1.

B.5.4.1 *Laboratory Control Sample*

The LCS is analyte-free water (for aqueous analyses), Ottawa sand, or other solid matrix demonstrated to be analyte-free (for soil analyses) spiked, at a minimum, with all chemicals of concern identified in Section 3 of the FSP. When the chemicals of concern are not identified for the project, the LCS shall be spiked with all analytes for which data are reported. The LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. The LCS shall be carried through the complete sample preparation and analysis procedure. The LCS is used to evaluate each analytical batch and to determine if the method is in control. If the recovery of any analyte in the LCS is outside control limits, the laboratory shall reextract and reanalyze all samples associated with the given LCS. Reanalysis is only required for the analytes outside of control limits. The LCS cannot be used as the continuing calibration verification.

Section 3 of the FSP identifies a LORP for all analytes of concern. When specified in Section 6 of the FSP, the laboratory shall successfully analyze an LCS at, or below, the LORP prior to analyzing project samples and once every 3 months during the life of the project for all analytes of concern for the project. Acceptance criteria for this QC spike sample are those contained in the QC acceptance criteria tables in QAPP Element B.5.1.

B.5.4.2 *Matrix Spike/Matrix Spike Duplicate*

The MS/MSD samples are aliquots of a sample spiked with known concentrations of all chemicals of concern identified in Section 3 of the FSP. When the chemicals of concern are not identified in the FSP, the MS/MSD shall be spiked with a subset of the analytes included in the laboratory's initial calibration standard mixture(s) that are representative of the range and characteristics of the calibrated analytes. The spiking occurs prior to sample preparation and analysis. The MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. Spike levels are only considered appropriate for assessing accuracy if they are less than four times the native sample concentration. Only TCEQ project samples shall be used for the MS/MSD analysis. The sample to be used for the MS/MSD shall be designated on the custody. The MS/MSD is used to document the bias of a method due to sample matrix. TCEQ does not use MSs and MSDs to control the analytical process.

Section 3 of the FSP identifies a LORP for all analytes of concern. When specified in Section 6 of the FSP, the laboratory shall successfully analyze a MS/MSD spike sample at, or below, the LORP prior to analyzing project samples and once every 3 months during the life of the project for all analytes of concern for a given project. Acceptance criteria for this QC spike sample are those contained in the QC acceptance criteria tables in QAPP Element B.5.1.

B.5.4.3 *Surrogates*

Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process but that are not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates shall be added to environmental samples, controls, and blanks, in accordance with the method requirements. The laboratory should follow method requirements and the procedures given in Section 9.6 of SW-846 Method 8000C should a surrogate recovery be outside control limits. Surrogate recoveries outside of control limits should be clearly identified in the laboratory data package.

B.5.4.4 *Internal Standards*

Internal standards (ISs) are measured amounts of certain compounds added after preparation or extraction of a sample. They are used in an IS calibration method to correct sample results affected by extraction losses, column injection losses, purging losses, or viscosity effects.

ISs shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

B.5.4.5 *Retention Time Windows*

Retention time windows are used in GC and high performance liquid chromatography (HPLC) analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846 Method 8000C.

B.5.4.6 *Interference Check Sample*

The interference check sample (ICS), used in inductively coupled plasma (ICP) analyses only, contains both interfering and analyte elements of known concentrations. The ICS is used to verify background and interelement correction factors.

B.5.4.7 *Method Blank*

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank shall be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

The presence of analytes in a method blank at concentrations equal to or greater than the MQI indicates a need for corrective action for samples in which the reported concentration is less than or equal to five times the associated blank concentration. Corrective action shall be performed to eliminate the source of contamination prior to

proceeding with analysis of these samples. After the source of contamination has been eliminated, all such samples in the analytical batch shall be reextracted/redigested and reanalyzed. No analytical data shall be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples, the data validator will evaluate the effect of the potential laboratory contamination on the quality of the data.

B.5.4.8 *Method Detection Limit, Method Quantitation Limit, and Sample Detection Limit*

The MDL shall be the concentration at which the false rejection decision error is $\leq 1\%$. The MDL, as defined in this QAPP, is the minimum concentration as determined by the procedures given in 40 CFR Part 136, Appendix B. The laboratory can either run an MDL determination on each instrument to be used for the project or run an MDL determination only on the least sensitive instrument and demonstrate that the qualitative identification criteria can be met on other instruments for all target analytes spiked into a QC check sample at a concentration equal to the MDL.

The MQL is equal to the lowest non-zero standard concentration in the laboratory's initial calibration curve based on the final volume or weight used by the laboratory. The MQL should be 5 to 10 times the MDL for the majority of target analytes but no lower than 3 times the MDL.

The laboratory shall report all non-detected results as less than the numeric value of the SDL. The SDL is defined as the MDL adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot for analysis due to matrix effects or the high concentration of some analytes. The SDL may be defined by the laboratory in such a manner as to allow rounding of MDLs upward to the next integer value higher than the MDL for the laboratory instrument with the least sensitivity but should be based on the MDL as defined in this subelement.

B.5.5 Field Quality Control Samples

B.5.5.1 *Field Blank*

The field blank consists of ASTM Type II reagent grade water poured into a VOC sample vial at the sampling site (in the same vicinity as the associated samples). It is handled like an environmental sample and transported to the laboratory for analysis. Field blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes. Field blanks are used to assess the potential introduction of contaminants from field sources (e.g., gasoline motors in operation, etc.) to the samples during sample collection.

Field blanks shall be collected at a frequency of one blank per 20 samples for each matrix. Field blanks shall be collected downwind of possible VOC sources.

B.5.5.2 *Equipment Blank*

An equipment blank (also known as a rinsate blank) is a sample of ASTM Type II reagent grade water poured into, over, or pumped through the sampling device; collected in a sample container; and transported to the laboratory for analysis. If the equipment is dedicated, no equipment blank shall be collected. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures.

Equipment blanks shall be collected at a frequency of one blank per equipment type per medium per day. Equipment blanks shall be collected immediately after the equipment has been decontaminated. The equipment blank should be analyzed for all laboratory analyses requested for the environmental samples collected with that equipment at the site.

B.5.5.3 *Trip Blank*

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes. Trip blanks are used to assess the potential introduction of contaminants during sample handling, transportation, and storage.

One trip blank shall accompany each cooler of samples sent to the laboratory for analysis of VOCs.

B.5.5.4 *Field Duplicates*

A field duplicate sample is a second, collocated sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field, such that they cannot be identified as duplicate samples (blind duplicate) by laboratory personnel performing the analysis. Specific locations are designated for the collection of field duplicate samples prior to the beginning of sample collection but can be adjusted based on field observations.

Duplicate sample results are used to assess the precision of the sample collection process and for evaluating the homogeneity of composite samples. The frequency of collection of field duplicates is specified in Section 4 of the FSP.

B.5.5.5 *Field Replicates*

A field replicate sample (also called a field split sample) is a single sample that is homogenized and divided into two equal parts for analysis. The sample containers are assigned an identification number in the field, such that they cannot be identified as replicate samples by laboratory personnel performing the analysis. Specific locations

are designated for collection of field replicate samples prior to the beginning of sample collection but can be adjusted based on field observations.

Replicate sample results are used to assess sampling precision, the laboratory analysis precision, and/or the performance between two or more laboratories. Precision of soil samples to be analyzed for VOCs is assessed from field duplicates (i.e., collocated samples) rather than field replicates because the process required to obtain uniform field replicate samples could result in significant loss of the compounds of interest. The frequency of collection of field replicates is specified in Section 4 of the FSP.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

A preventive maintenance program shall be in place to promote the timely and effective completion of a measurement effort. The preventive maintenance program is designed to minimize the downtime of crucial sampling and/or analytical equipment due to unexpected component failure. In implementing this program, efforts are focused in three primary areas:

- a) establishment of maintenance responsibilities;
- b) establishment of maintenance schedules for major and/or critical instrumentation and apparatus; and
- c) establishment of an adequate inventory of critical spare parts and equipment.

Specific requirements for field instrumentation for a given project shall be specified in Section 5 of the FSP.

B.6.1 Maintenance Responsibilities

Maintenance responsibilities for equipment and instruments are assumed by the respective facility managers. The managers then establish maintenance procedures and schedules for each major equipment item. This responsibility may be delegated to laboratory personnel, although the managers retain responsibility for ensuring adherence to the prescribed protocols.

B.6.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. Other maintenance activities are conducted as needed. Manufacturers' recommendations provide the primary basis for the established maintenance schedules, and manufacturers' service contracts provide primary maintenance for many major instruments (e.g., GC/mass spec instruments, ICP spectrometers, and analytical balances).

B.6.3 Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment downtime. The inventory includes those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner should failure occur.

Field sampling task leaders and the respective laboratory managers are responsible for maintaining an adequate inventory of spare parts. In addition to spare parts and supply inventories, the Contractor shall maintain an in-house source of backup equipment and instrumentation.

B.6.4 Maintenance Records

Maintenance and repair of major field and laboratory equipment shall be recorded in field or laboratory logbooks. These records shall document the serial numbers of the equipment, the person performing the maintenance or repairs, the date of the repair, the procedures used during the repair, and proof of successful repair prior to the use of the equipment.

B.7 Instrument/Equipment Calibration and Frequency

Instruments and equipment used to generate or measure environmental data will be maintained and calibrated according to manufacturer specifications, the requirements of the analytical method, and the QC requirements specified in Element B5. Element B.5.1 includes a discussion of required quality, calibration and tuning criteria, control checks, frequencies, acceptance criteria, and corrective actions associated with routine analytical methods. Calibration and tuning of laboratory instruments is the responsibility of the laboratory.

Field instrument calibration and frequency requirements for pH, temperature, conductivity, dissolved oxygen, redox potential, turbidity, and alkalinity measurements are summarized in Element B.5.2. Specific requirements for other field instrumentation for the project are specified in Section 5 of the FSP.

B.8 Inspection/Acceptance of Supplies and Consumables

Any laboratory consumables or supplies that come into contact with samples must be documented to be free of contamination ("clean"). Examples of laboratory consumables and supplies include: gloves, glassware, soaps, sample bottles, water, reagents, and pipettes.

Documentation that laboratory consumables and supplies are clean may be achieved through several methods as follows:

- Collection of QC samples, such as bottle blank, water blank, or reagent blank samples. Bottle blanks demonstrate the bottles are free of contamination. Water blanks demonstrate the deionized/distilled water does not contain contamination. Reagent blank samples demonstrate the reagents are free from contamination.
- Certifications from manufacturers or laboratories may be used to show that bottles, consumable equipment and other supplies are free of contamination.
- Purchasing through reliable and frequently used sources. A restricted list of common items may be assumed to be "clean", until proven otherwise, if purchased from reliable commercial sources. This restricted list includes gloves and other personal protective equipment, paper towels, plastic bags, aluminum foil, or other similar items. If the "clean" certification provided by the vendor has been compromised, e.g., tears in the packaging, decontamination should be performed prior to use or the item should be discarded if it cannot be adequately decontaminated. Items purchased through commercial sources, and not documented to be "clean", should not be used in direct contact with samples.
- The laboratory will have on file, and available upon request, the documentation describing the process the laboratory uses to document consumables and supplies are "clean".

The laboratory QAP should clearly identify other critical supplies, such as calibration gases or standards, the inspection or acceptance testing requirements and the acceptance criteria. Critical field supplies, the inspection or acceptance testing requirements, and the acceptance criteria are included in Section 5 of the FSP.

B.9 Non-direct Measurements

For all types of data needed for project implementation or decision making that are obtained from non-direct measurement sources (e.g., computer databases, programs, literature files, and historical databases), the acceptance criteria for use of these data, and the limitations on the use of the data will be clearly identified and specified in Section 1 of the FSP.

B.10 Data Management

Data storage/retrieval requirements are specified in Element A.9.7 of this QAPP.

B.10.1 Logbooks and Forms

Laboratory and field records shall be kept by appropriate personnel and shall be sufficiently detailed to allow for the reconstruction of the collection, handling, preparation, and analysis procedures performed on the sample without having to rely upon recollection by members of the sampling and/or analysis team. All aspects of sample collection, handling, preparation, and analysis shall be documented in logbooks or forms. If SOPs are being followed, those SOPs shall be maintained. It is

sufficient to identify the SOPs being followed and record in the field logbook any deviations from the procedures in the SOP. All logbook pages shall be initialed and dated by the person making the entries. All entries should be legible. If errors are made when making entries, the error must be crossed out with a single line and initialed and dated by the person correcting the entry. All maintenance and calibration records for equipment must be traceable through records to the person using the instrument and to the specific piece of instrumentation.

The PRP or the TCEQ Contractor will transmit to the TCEQ PM the hard copy, and when requested, the electronic copy, of the project data generated in the field or the laboratory. The TCEQ PM will archive project data in the project files according to the program file structure as described in Element A.9.7.

C.O ASSESSMENT AND OVERSIGHT

C.1 *Assessments and Response Actions*

External assessments, inspections, and/or audits shall be performed by parties independent of the organization, such as NELAP or The American Association for Laboratory Accreditation (A2LA), pertaining to the laboratory. In addition, laboratory inspections of TCEQ and contracted laboratories, unless exempted by TWC §5.134 and 30 TAC §25.6, shall be performed by the Texas Laboratory Accreditation Program once before accreditation is issued and once every 2 years thereafter, unless interim accreditations are issued.

A technical systems audit of field activities is an on-site, qualitative review of the sampling system to ensure that the activity is being performed in compliance with the QAPP specifications. Field and sampling procedures shall be audited by the TCEQ at a frequency specified in the annual assessment plan for the program.

Generalized items for a technical systems audit of field activities will include (as pertinent to the project):

- on-site presence and use of required documents (SOPs, QAPP, FSP, relevant laboratory specifications, etc.);
- appropriate collection of planned sample types and quantities at specified sites, locations, and environmental media according to the QAPP and FSP;
- use of SOPs and FSP specifications for the collection, tracking, labeling, and custody of samples and for the decontamination of equipment;
- field form preparation of location and sampling information and logbook documentation of field events and measurements;
- fulfillment of project quality assurance objectives including precision, accuracy, completeness, comparability, and representativeness as these relate to field measurements, sample collection, data traceability, and sampling rationale;
- field instrument calibration and documentation;
- general field crew organization and knowledge of the field sampling plan and technical issues relevant to the tasks being conducted;
- deviations from the QAPP, FSP and SOPs that are clearly documented, with indications as to how and why the deviations were made, and any approvals needed to proceed with the deviations; and
- handling and documentation of investigation-derived waste and coordination of disposal of the various types of waste.

Specific items related to the collection of samples for laboratory analysis will include (as pertinent):

- Sample location and adherence to the plan;

- Field instrumentation and calibration;
- Sample collection protocol;
- Sample volume;
- Sample preservation;
- Blanks collected and submitted with each respective sample set;
- Duplicates collected and submitted with each respective sample set;
- Sample documentation protocols;
- Custody protocols; and
- Sample shipment

After each on-site audit, an audit exit meeting will be held for all participants to discuss the preliminary audit results. The auditor will then complete the audit evaluation and submit an audit report to the program including observations of the deficiencies and the necessary recommendations for corrective actions. Compliance with the specifications presented in the QAPP will be noted and noncompliance or deviations shall be addressed in writing by the Contractor to the TCEQ with the corrective actions and a time frame for implementation of the corrective actions. Follow-up audits will be performed prior to completion of the project to ensure corrective actions have been implemented.

Deviations from the QAPP, SOPs, or FSP, and the effect of the deviations on the quality of the associated data, will be documented in the DUS as described in the subsection “Corrective Actions and Workplan Deviations” under Element D.2.3.2 of this QAPP. Additionally, at the request of the TCEQ PM, the TCEQ project QAS will conduct an audit of data quality on the project data as described in Element D.3.1.2.

For federally-funded activities, conformance with program quality system requirements is evaluated through program related QA assessment activities detailed in the program annual assessment plan. The program assessment plan addresses the number, frequency, responsible staff, and type of assessments to be conducted. In addition, other project-specific assessment activities to be performed during the life of the project may be specified in Section 1 of the FSP.

The types of assessment activities may include, but are not limited to, one or more of the following:

- Management Systems Review (MSR);
- Readiness Review;
- Surveillance;
- Technical Systems Audit (TSA);
- Performance Evaluation (PE);
- Audit of Data Quality (ADQ);

- Peer Review; and
- Data Quality Assessment (DQA).

The lead QAS will monitor conformance with program quality system requirements and communicate in writing to the Superfund Section manager or to the VCP-CA Section manager, as applicable to the program, any observed systematic problems, deficiencies, and/or adverse trends in the program quality system. As applicable to the program, the Superfund section manager or the VCP-CA Section manager will:

- decide if corrective actions are needed and will communicate the findings in writing to the persons responsible for implementing corrective action(s);
- monitor the implementation and effectiveness of the corrective action(s) proposed to address the systematic problems, deficiencies, and/or adverse trends;
- include the lead QAS on written communications issued and received regarding corrective actions;
- keep the lead QAS apprised of the status of the corrective action measures; and
- provide written justification when corrective action(s) are not deemed necessary.

The TCEQ PM provides contractual oversight of field and sampling activities. The project-specific work to be performed by the Contractor is defined in the FSP and work order. The TCEQ PM is responsible for verifying Contractor adherence to the contract, work order, QAPP, and FSP. The Contractor is required to issue a report documenting the project objectives, the sampling plan requirements, and the description of the Contractor activities conducted in the field to meet these requirements. The TCEQ PM reviews the report for compliance and approves the report.

The TCEQ PM may conduct in-field oversight of Contractor activities. When conducting in-field oversight, the TCEQ PM documents the field activities observed and advises the Contractor to implement corrective action if the activities are not in compliance with the FSP or QAPP.

C.2 Reports to Management

Audit of data quality reports associated with the technical review of DUS reports shall be submitted to the TCEQ PM during the course of the project to ensure that problems arising during the sampling and analysis phases of the project are investigated and corrected. The TCEQ PM shall ensure that significant findings from the audit of data quality reports are documented in the monthly progress report to TCEQ management, the TCEQ QA Section and EPA. The DUS reports shall include the Contractor evaluation of the accuracy, precision, and completeness of the data, and will contain as applicable to the project:

- Data validation and assessment results since the last report;
- Field and laboratory audit/assessment results since the last report;

- Significant QA/QC problems, recommended solutions, and results of corrective actions;
- Assessment of data generated since last report, including consideration as to whether originally targeted objectives are being met through the implemented plan(s); and
- Minor deviations from the field sampling plan or QAPP (Note: Major changes to procedures and/or responsibilities require prior approval from the TCEQ.).

D.0 DATA VALIDATION AND USABILITY

D.1 Data Review, Verification, and Validation

D.1.1 Criteria for Accepting, Rejecting, or Qualifying Data

Data review performed by the laboratory shall be conducted in accordance with the criteria specified below in Element D.2.1.1. The process used by the independent data reviewer (i.e., the person reviewing and qualifying the data who is independent of the laboratory) is specified in Element D.2.1.2 below. The data review results shall be summarized in a DUS described in Element D.2.3.1 below. Project data generated under the CLP and validated by the Environmental Services Assistance Team (ESAT), shall not be subject to the data review and validation procedures described in this QAPP.

Qualification of data by the independent data reviewer shall be directly related to potential bias and imprecision in the results and should not be confused with qualification based on laboratory performance. Review qualifiers used in preparing the DUS shall be assigned to data by the independent data reviewer to warn data users of potential uncertainty in the data, regardless of whether the laboratory was expected to provide better results. Therefore, only one set of accuracy and precision criteria for organic results and one set for inorganic results shall be used in determining whether or not a given sample result needs to be flagged as estimated. For example, if an organic result is not flagged as estimated or rejected, the end user shall know that the results are considered likely to be accurate to within $\pm 40\%$ and precise within about 40%. Conversely, any organic result flagged as estimated is likely to differ from the reported value by 40% or more. These limits are provided in Table D.1.1-1.

Table D.1.1-1 Acceptance Criteria for Accuracy and Precision

Chemical Class	ACCURACY ¹ (% RECOVERY)	PRECISION ² (RELATIVE PERCENT DIFFERENCE)
Organics	60% to 140%	40%
Inorganics	70% to 130%	30%
PCDDs/PCDFs	60% to 140%	40%

¹ Accuracy acceptance criteria are pertinent to the matrix spike, the laboratory control sample, the post digestion spike, and surrogate recoveries.

² Precision acceptance criteria are pertinent to laboratory duplicates, matrix spike duplicates, and duplicate laboratory control samples.

During the data review process, the person reviewing the data shall annotate qualified data on the analytical data sheets with appropriate data review qualifiers (“U”, “J”, “UJ”, “N”, “NJ” and “R”) as listed in Table D.1.1-2 and associated qualifier codes and bias codes as listed in Table D.1.1-3. The purpose of the qualifier codes is to provide

information with respect to the data quality condition(s) that resulted in the assigned qualification. The bias code provides an indication of the potential direction of the bias. A hyphen and then the applicable qualifier code shall follow the data review qualifier and bias code. For example, "JL-LCS" would mean the result was qualified for laboratory control sample spike recoveries, which were outside of the acceptance criteria, resulting in a potential low bias in the reported value. In the case of multiple data quality conditions resulting in qualification, each qualifier code is listed and separated by a comma. For example, a result qualified as estimated due to low LCS spike recovery (%R = 30%) and poor field duplicate precision (RPD > 50%) would have the following codes annotated on the data sheet, "JL-LCS, FD".

Table D.1.1-2 Data Review Qualifier Definitions

Qualifier	Definitions
U	Not detected: The analyte was analyzed for but was not detected above the level of the associated value. The associated value is the sample detection limit (SDL).
J	Estimated: The analyte was detected and positively identified. The associated numerical value is the approximate concentration of the analyte in the sample.
UJ	Not detected, SDL is estimated: The analyte was analyzed for but was not detected above the reported sample detection limit. However, the reported SDL is an estimate and may be inaccurate or imprecise.
N	Tentatively identified: The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.
NJ	Tentatively identified, reported concentration is estimated: The analysis indicates the presence of an analyte. Presumptive evidence is used to make a tentative identification, and the numerical value represents the approximate concentration.
R	Rejected: The data are unusable. (Note: The presence or absence of the analyte cannot be confirmed.)
X1	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The laboratory is an on-site or in-house laboratory, defined in 30 TAC 25, and inspected at least every 3 years by TCEQ.
X2	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The laboratory is an on-site or in-house laboratory, defined in 30 TAC 25, is located outside of Texas, and is accredited or periodically inspected by that state.
X3	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The laboratory is an on-site or in-house laboratory, defined in 30 TAC 25, is inspected at least every 3 years by the TCEQ, and the work is performed for another company with a unit located on the same site as the laboratory.
X4	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The laboratory is an on-site or in-house laboratory, defined in 30 TAC 25, is inspected at least every 3 years by the TCEQ, and the work is performed without compensation for a governmental agency or a charitable organization.
X5	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The laboratory is accredited under federal law, including certification by the EPA to provide these data for decisions related to the Safe Drinking Water Act.
X6	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The laboratory provides these data necessary for emergency response activities and the required analytical data are not available from a laboratory accredited under the Texas Laboratory Accreditation Program.
X7	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The TCEQ does not offer accreditation for this analyte, in this matrix, analyzed by this method.
X8	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The TCEQ offers accreditation for this analyte in this matrix by this method, but the laboratory is not accredited for this analyte in this matrix by this method. The analyte result is validated and reported as part of a suite of analytes for the method.
X9	The laboratory is not accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The analyte result was generated prior to July 1, 2008.

Table D.1.1-3 Data Review Qualifier Codes

Qualifier Code	Data Quality Condition Resulting In Assigned Qualification
General Use	
FB	Field blank contamination
FD	Field duplicate evaluation criteria not met
HT	Holding time requirement was not met
PR	Preservation requirements not met
LCS	Laboratory control sample evaluation criteria not met
MB	Method blank or preparation blank contamination
RB	Rinsate blank contamination
TB	Trip blank contamination
SDL	Sample detection limit exceeds decision criteria (for nondetected results)
Inorganic Methods	
ICAL	Initial calibration evaluation criteria not met
CCB	Continuing calibration blank contamination
CCV	Continuing calibration verification evaluation criteria not met
D	Laboratory duplicate precision evaluation criteria not met
DL	Serial dilution results did not meet evaluation criteria
ICS	Interference check sample evaluation criteria not met
ICV	Initial calibration verification evaluation criteria not met
MS	Matrix spike recovery outside acceptance range
PDS	Post-digestion spike recovery outside acceptance range
MSA	Method of standard additions correlation coefficient <0.995
PB	Preparation Blank
Organic Methods	
ICAL	Initial calibration evaluation criteria not met
CCAL	Continuing calibration evaluation criteria not met
ID	Target compound identification criteria not met
IS	Internal standard evaluation criteria not met
MS/SD	Matrix spike/matrix spike duplicate accuracy and/or precision criteria not met
SUR	Surrogate recovery outside acceptance range
TUNE	Instrument performance (tuning) criteria not met
P	Detected concentration difference between the primary and secondary column is greater than 25%
Bias Codes	
H	Bias in sample result likely to be high
I	Bias in sample result is indeterminate
L	Bias in sample result likely to be low

D.1.2 Project Specific Calculations or Algorithms

The project specific calculations are specified in Element B.5.3 and in the FSP.

D.2 Verification and Validation Methods

D.2.1 Process for Data Verification and Validation

The review performed on the data at every level shall be documented, beginning with the laboratory's review of the analytical results onward through the independent data review performed for, or by, the data user, and finally the review by the TCEQ. The intent is to capture the review effort of each party to minimize duplicative activities, to ensure that critical elements of the review process are not overlooked, and to set in place a system that can be audited or inspected. The laboratory will have in place and will implement a quality assurance program that meets the requirements of a recognized organization, such as EPA or NELAP, therefore, problems with the data should be random, minimal, appropriately addressed through laboratory corrective action procedures, and adequately documented in the LRCs. The independent data review will not duplicate the laboratory review. Instead, the independent data reviewer will review the sample performance criteria, spot-check for accuracy the review performed by the laboratory, and then rely on review of the laboratory report of problems associated with the laboratory performance criteria to evaluate the quality and usability of the associated analytical results.

Element D.2.1.1 describes the first level of review performed by the laboratory. The second level of review of the analytical data shall be performed as specified in Element D.2.1.2 by data review personnel independent of the laboratory generating the data. The purpose of this second level of review is to provide an independent review of the laboratory data package, including the LRCs, and to evaluate the effect(s) of any QC measures not meeting the QC acceptance criteria on the usability of the analytical data. Element D.2.1.3 describes the level of review performed during data validation by the independent data reviewer. The final review performed by the TCEQ is specified in Elements D.3.1 and D.3.2.

D.2.1.1 *Data Review by the Laboratory*

The laboratory shall review the data for technical acceptance based on the project requirements specified in the FSP and Element B.5. The results of the laboratory review shall be documented in the LRC described in A.9.2.1. If no project-specific acceptance criteria have been specified, then the review shall be based on the method requirements. The laboratory will review the data reduction and verification procedures used in the laboratory to assure the overall analysis results and reporting protocols meet method and project specifications. The procedures for data reduction, reporting, and review, as described in this element, shall be included in the

laboratory's QAP and SOPs to assure: (1) complete documentation is maintained; (2) transcription and data reduction errors are minimized; (3) the data are reviewed and the review documented; and (4) the reported results are qualified to reflect potential limitations of the data, when necessary. The laboratory should have a QA program in place that identifies and corrects problems associated with the generation of analytical data. The specific data reduction, verification, and reporting procedures may vary from laboratory to laboratory but shall be completed in accordance with the laboratory's QAP and the laboratory SOPs.

The laboratory analyst responsible for the reduction of raw data generated at the laboratory bench shall document the outcome of his/her activities and clearly identify any problems or anomalies that might affect the quality of the data being reported. The analyst shall verify that data reduction performed by an instrument or Laboratory Information Management System (LIMS) is correct. In each laboratory analytical section, the analyst performing the tests shall review 100 percent of the data, and the verification by laboratory personnel shall, at a minimum, include the following:

- Verification of the calibrations and calibration checks for compliance with laboratory criteria and criteria specified in Element B.5 of this QAPP.
- Verification that batch QC samples were analyzed at the frequency specified in the method and in Element B.5 of this QAPP.
- Verification that QC sample results were within the specifications in the method and in Element B.5 of this QAPP.
- Comparison of the raw data (chromatograms, mass spectra, etc.) with the reported identifications and concentrations for accuracy and consistency.
- Verification that holding times for extractions and analyses were met.
- Verification that sample detection limits and method detection limits are current and correct.
- Verification that corrective actions were performed and control was adequately reestablished and documented prior to reanalysis of QC or project samples.
- Verification that all project and QC sample results were properly reported and flagged.
- Preparation of LRCs as specified in Element A.9.2.1.

After the analyst's review has been completed, at least 10% of the following data (as applicable to the analytical method) shall be reviewed independently by a senior analyst or by the supervisor of the respective analytical section using the criteria specified above and/or in Element B.5 of this QAPP:

- Calibrations and calibration verifications;

- Instrument and system performance checks (e.g., tuning, performance evaluation mixture analysis, etc.);
- Blanks;
- LCS recoveries and precision;
- MS/MSD recoveries and precision;
- Duplicate sample precision;
- Compound quantitation and identification;
- Surrogate recoveries ;
- Internal standard areas ;
- Serial dilutions;
- Post-digestion spike recoveries;
- Method of Standard Addition quantitation;
- Interference check sample results; and
- Tentatively Identified Compound identifications.

The Laboratory QA section shall: 1) review the completed data packages, 2) perform a reasonableness check review on all the completed data packages, and 3) ensure that all deliverables are present, that qualifiers have been applied to the data, that the custody has been maintained and is documented, and that all nonconformance and other issues have been addressed in the LRC to be included in the data report packages. The laboratory QA section shall perform a QA check on 100% of data key-punched into electronic data deliverables and shall perform a 5% spot-check of data electronically transferred into an electronic data deliverable for consistency with hard copy deliverables.

D.2.1.2 *Data Usability Review by the Independent Data Reviewer*

The independent data reviewer (i.e., the person independent of the laboratory who is reviewing the data) shall review all of the reportable data and the LRCs. The results of the data usability review shall be conveyed to the data user(s) in the data review memorandum, described in Element D.2.3.1, or a data usability summary as described in Element D.2.3.2 below.

D.2.1.2.1 Review of the Laboratory Review Checklist

The independent data reviewer shall evaluate the sample-specific criteria and the laboratory performance criteria based on the review of the LRCs. During the review of the LRCs, the data reviewer must evaluate the appropriateness of an “NA” or “NR” response by the laboratory considering the methods used for the analysis of the

samples. If an ER describes a laboratory performance criterion not covered by the subsections below, if appropriate, the person reviewing the data shall evaluate and qualify the associated data using guidance from the EPA National Functional Guidelines for Organic/Inorganic Data Review as applicable to the analytical method (See Element A.0). If the Functional Guidelines are not considered appropriate, the person reviewing the data shall utilize professional judgment to evaluate the effect of the reported item or condition on the associated analytical data. All uses of professional judgment shall be described in the narrative describing the data review. In some cases, it may be appropriate for the data reviewer to assign the final accuracy and precision qualifications from Table D.1.1-1 based on the overall performance of the applicable QC parameters (e.g., LCS, MS/MSD, blank results) rather than relying solely on the QC results associated with an individual analytical batch.

D.2.1.2.1.1 Initial Calibration

Element B.5.1 contains the QC acceptance criteria for initial calibration for analytical methods required for a specific project. If no site-specific QAPP is available, the acceptance criteria specified in the analytical method shall be used. If the LRC indicates the initial calibration for any analyte did not meet the acceptance criteria, then all results for that given analyte associated with the initial calibration shall be qualified as estimated (“J/UJ”) with a qualifier code of “ICAL” and a bias code of “I” for indeterminate direction of bias.

D.2.1.2.1.2 Initial and/or Continuing Calibration Verification

Element B.5.1 contains the QC acceptance criteria for initial calibration or continuing calibration verification for analytical methods required for a specific project. If no site-specific QAPP is available, the acceptance criteria specified in the analytical method shall be used. If the LRC indicates the initial or continuing calibration verification for any analyte did not meet the acceptance criteria, then all results for that given analyte associated with the initial or continuing calibration verification shall be qualified as estimated (“J/UJ”) with a qualifier code of “ICV” or “CCV” for inorganics and “CCAL” for organics. If the data reviewer can discern a probable magnitude and/or direction of bias to the associated sample results, based on the information provided in the ER, then appropriate qualifier bias codes shall be assigned.

D.2.1.2.1.3 Internal Standard Data

Element B.5.1 contains the QC acceptance criteria for internal standard (IS) area counts for GC/mass spec organic analysis and IS quantitation methods required for the project. If no site-specific QAPP is available, the acceptance criteria specified in the analytical method shall be used. The IS area counts are not a direct measure of the accuracy of the analysis. Low IS area counts for sample analysis relative to those observed in the associated continuing calibration analysis may be indicative of low

extraction or purging efficiency, which decreases the analysis sensitivity (raises the detection limit). High IS area counts may be indicative of coeluting interferences at the retention time of the IS in the sample and may be caused by a drift in detector sensitivity or by injection of a different amount of sample extract. Coeluting interferences to the IS may result in a low bias in reported results quantified by the given IS. Injection of a larger volume of extract would result in increased sensitivity of the analysis (lowered detection limit).

- If the ER indicates IS area counts are below the lower acceptance limit, then results reported as not-detected shall be qualified as estimated (“UJ”), and results reported as detected will not require qualification since the calculation performed by the instrument corrects for reduced extraction efficiency.
- If the ER indicates that IS area counts are above the upper acceptance limit, then results reported as detected or as not-detected shall be qualified as estimated (“J/UJ”).

A qualifier code of “IS” shall be assigned to all results qualified on the basis of IS area counts.

D.2.1.2.1.4 Dual Column Confirmation Results

A second, dissimilar column confirmation is required by some of the GC analysis methods. If the ER specifies the relative percent difference between primary and secondary column results for organic analysis by GC is greater than 25%, the following qualification shall be considered:

- If the ER indicates that the RPD is greater than 40%, and that the difference is likely due to coeluting interference, the person reviewing the data shall qualify the reported sample results as presumptive evidence of presence at an estimated quantity (“NJ”). If the result reported by the laboratory was the higher of the two results, then the person reviewing the data may cross out the reported result and replace it with the lower of the two results, if there is evidence that the higher value is caused by coeluting interference.
- If the samples analyzed would not be considered as previously well-characterized as to constituents present and second column confirmation was not performed for a GC analysis, the reported sample results may be qualified as presumptive evidence of presence at an estimated quantity (“NJ”).

D.2.1.2.1.5 Interference Check Sample

ICS analysis is applicable to ICP-mass spec and ICP-AES analysis. Element B.5.1 contains the QC acceptance criteria for ICS results for analytical methods required for a specific project.

- If the ER indicates that the %R for analytes present in the ICS sample was above the upper acceptance criterion, then results reported as detected for that analyte in associated samples for which the potentially interfering elements were present at concentrations equivalent to or greater than those present in the ICS sample shall be qualified as estimated (“JH”) with a potential high bias; non-detected results do not require qualification.
- If the ER indicates that the %R for analytes present in the ICS sample was less than the lower acceptance criterion, then both detected and non-detected results for that analyte in associated samples for which the potentially interfering elements were present at concentrations equivalent to or greater than those present in the ICS sample shall be qualified as estimated (“J/UJL”) with a potential low bias.
- If the ER indicates that analytes not actually present in the ICS sample are reported at concentrations for which the absolute value of the concentration is greater than the sample detection limit for the analyte, then the potential effect and magnitude of the bias shall be evaluated for all associated samples for which the potentially interfering elements were present at concentrations equivalent to or greater than those present in the ICS sample.
- If the concentration is reported as a positive value and the magnitude of the ICS-A sample result represents more than 25% of an associated sample result reported as detected, then the associated sample result shall be qualified as estimated (“JH”) with a potential high bias. Non-detected results shall not require qualification.
- If the concentration is reported as a negative value and the absolute value of the magnitude of the ICS-A sample result represents more than 25% of an associated sample result (or sample detection limit for non-detects), then the associated sample result shall be qualified as estimated (“J/UJL”) with a potential low bias.

A qualifier code of “ICS” shall be assigned to all results qualified on the basis of ICS results.

D.2.1.2.1.6 Serial Dilution Analysis Data

Serial dilution analysis may be pertinent to metals analysis by ICP-AES, ICP-mass spec, and GFAA. The ICP serial dilutions are run to help evaluate whether or not significant physical or chemical interferences exist due to the sample matrix. When analyte concentrations are sufficiently high (the concentration in the original sample is minimally a factor of 50 above the IDL), the results obtained from a five-fold dilution of the original sample are compared to the original results by means of a percent difference (%D). The %D is compared to a precision acceptance limit of $\pm 10\%$. If the absolute value of the percent difference between the diluted and original result is greater than 10%, all results for that analyte in that sample batch are qualified as estimated (“J/UJ-DL”). Generally, the diluted result can be considered to be the more accurate result, as long as the diluted concentration is well above the detection limit.

Therefore, the person reviewing the data can generally discern a potential bias direction from a comparison of the diluted and undiluted results.

A qualifier code of “DL” shall be assigned to all results qualified on the basis of serial dilution results.

D.2.1.2.1.7 Post Digestion Spike Data

Post digestion spike analysis may be pertinent to metals analysis by ICP-AES, ICP-mass spec and GFAA. The analyte recoveries obtained for post-digestion spike analyses shall be compared to the acceptance range for accuracy contained in Table D.1.1-1 (70-130%). Under some circumstances, laboratories will quantify results by the Method of Standard Additions (MSA) to compensate for low post-digestion spike recovery. The low spike recovery will not compromise the accuracy of the results, as the standards used in the MSA analysis are spiked directly into the sample. However, if the result for the sample on which the post-digestion spike analysis was performed was not obtained by the Method of Standard Additions and the post-digestion spike recovery is outside of the acceptance limits, qualify the result for the sample on which the post-digestion spike was run based on the following guidance:

- If the recovery is above 130%, qualify detectable results as estimated (“J”). No action needs to be taken for non-detects.
- If the recovery is below 70% but greater than or equal to 30%, qualify detectable and non-detected results as estimated (“J/UJ”).
- If the recovery is less than 30%, qualify detectable results as estimate (“J”) and reject non-detected results.

The person reviewing the data shall use professional judgment in conjunction with other QC sample results, such as matrix spike recoveries, to determine the need for qualification of results for other samples (if any) associated with the post-digestion spike analysis.

A qualifier code of “PDS” shall be assigned to all results qualified or rejected on the basis of post-digestion recoveries.

D.2.1.2.1.8 Method of Standard Additions Data

Method of Standard Additions quantitation of results may be pertinent to inorganic analyses. MSA may either be by the single-addition technique or using a series of standard additions. The single-addition technique is only considered valid if the apparent concentrations from the original calibration curve are linear over the concentration range of concern. If the single-addition technique is used, the laboratory shall document the slope of the MSA curve, the slope of the calibration curve, and the percent difference between the slopes of the MSA and the calibration curve. If a multiple addition MSA technique is used, the laboratory shall document the correlation

coefficient for the MSA plot and the control limits utilized for the correlation coefficient.

D.2.1.2.2 Review of Reportable Data

The independent data reviewer shall review the reportable data for all of the laboratory data packages from each laboratory for each analysis type. Data review shall be conducted from the results reported on the summary forms and/or test reports using the provisions below and guidance from EPA National Functional Guidelines for Organic/Inorganic Data Review (the Functional Guidelines), as applicable to the analytical method. No recalculation of results from the raw data or transcription error checking shall be performed during the review of the reportable data.

D.2.1.2.2.1 Metals and Inorganic (General Chemistry) Analyses

Metals data from ICP-mass spec, ICP, CVAA, or GFAA analyses and other inorganic (i.e., general chemistry) data shall undergo evaluation from the reported results for the following sample-specific criteria using the specifications given below and the criteria from Table D.1.1-1:

- Holding times;
- Blank results;
- Laboratory control sample results;
- Matrix spike sample analysis;
- Matrix spike duplicate or analytical duplicate precision;
- Field duplicate result agreement;
- Anion/cation balance;
- Balance of total to partial analyses; and

The person reviewing the data shall use guidance from the EPA Functional Guidelines to address issues not covered by this Element D.

D.2.1.2.2.1.1 Holding Times

The holding times shall be compared to the holding time requirements specified in Element B.2.2, Table B.2.2-1. If no holding time requirements are specified in the QAPP, the holding time requirements specified in the method shall be used. Results for analyses not performed within holding time limits shall be qualified as estimated ("J/UJ-HT"). If the holding time is grossly exceeded for mercury or chromium 6+ (more than two times the holding time limit), the data reviewer shall use professional judgment to evaluate the need to reject non-detected results.

A qualifier code of "HT" shall be assigned to all results qualified or rejected on the basis of holding times.

D.2.1.2.2.1.2 Blank Results

The results for method blanks, rinsate blanks, and other blanks reported in the data package shall be reviewed. If the associated sample matrix is a solid, positive associated aqueous blank results shall be converted to equivalent concentrations in the solid samples by assuming that all contamination found in the aqueous blank aliquot analyzed is potentially present at up to five times that amount in the solid sample aliquot analyzed. Sample results for analytes detected in an associated blank at concentrations less than five times the equivalent blank concentration shall be qualified as nondetect ("U") at the reported concentration. Negative blank concentrations shall be evaluated for potential effects (low bias) on sample data when the absolute value of the negative concentration is greater than the method quantitation limit (MQL). If the negative concentration in a blank may potentially have produced more than a 25% effect on a reported sample result or sample detection limit, the associated sample result shall be qualified as estimated ("J/UJ"). For example, if the blank result is -2 mg/L, the MQL is 1 mg/L and the associated sample result is 5 mg/L, the sample result shall be qualified since a potential low bias of 2 mg/L represents 40% of the reported concentration and the absolute value of the blank concentration is greater than the MQL.

If the LRC documents an exception report for Item R5, because the concentration of the analyte, unadjusted for sample specific factors, in an environmental sample was greater than 10 times the concentration of the analyte detected in a laboratory blank sample, the analytical result shall be considered detected in the sample and not qualified "U".

Preparation blanks are associated with all samples included in the preparation batch. Continuing calibration blank samples are considered to be associated with all samples back to the previously analyzed continuing calibration blank sample and up to the next continuing calibration blank sample in the analytical run. The appropriate qualifier code, e.g., "MB" or "RB", shall be assigned to all results qualified on the basis of blank data.

D.2.1.2.2.1.3 Laboratory Control Sample Analysis

The analyte recoveries obtained for LCS analyses shall be compared to the acceptance range contained in Table D.1.1-1 (i.e., 70-130%). All chemicals of concern shall be spiked into the LCS. Data associated with LCS recoveries outside the acceptance range shall be qualified as follows:

- If the LCS recovery for an analyte is greater than 130%, suggesting a potential high bias in reported results, all positive results for that analyte in all associated samples shall be qualified as estimated ("JH"), whereas nondetect results shall be considered to be acceptable for use without qualification.

- If the LCS recovery for an analyte is less than 70% but greater than or equal to 30%, suggesting a potential low bias in reported results, positive and nondetect results for that analyte in all associated samples shall be qualified as estimated (“JL” or “UJL”).
- If the LCS recovery for an analyte is <30%, positive sample results shall be qualified as estimated (“JL”) whereas nondetect results shall be qualified as unusable (“R”) for all associated sample results.

A qualifier code of “LCS” shall be assigned to all results qualified as estimated or rejected on the basis of LCS recoveries.

D.2.1.2.2.1.4 Duplicate Sample Analysis

Results for the duplicate sample, i.e., an analytical duplicate or the matrix spike duplicate, analyses shall be compared to the acceptance criteria contained in Table D.1.1-1. The RPD criterion of 30% shall be applied for cases in which both the sample and duplicate results are greater than or equal to five times the method quantitation limit. Otherwise, the absolute difference between the samples shall be compared to the higher SDL for aqueous samples and two times the higher SDL for solid samples. If the duplicate results for an analyte do not satisfy the applicable evaluation criterion, results for that analyte in all associated samples shall be qualified as estimated (“J/UJ”).

A qualifier code of “D” shall be assigned to all results qualified on the basis of laboratory duplicate results.

D.2.1.2.2.1.5 Matrix Spike Sample Analysis

The analyte recoveries obtained for matrix spike (or matrix duplicate) analyses shall be compared to the %R acceptance criteria contained in Table D.1.1-1 (70-130%) when the native sample concentration is less than four times the spike concentration, as specified in the Functional Guidelines. When the sample concentration of an analyte is greater than four times the spiking concentration, the result is considered inappropriate for assessing accuracy. The reviewer shall be aware that a matrix spike recovery may be outside acceptance limits when the parent sample was quantified using the Method of Standard Additions but the matrix spike was not. In such a case, the %R for the MS may not be an appropriate measure of accuracy. Data associated with matrix spike recoveries outside the acceptance range shall be qualified as follows:

- If the matrix spike recovery for an analyte is greater than 130%, suggesting a potential high bias in reported results, all positive results for that analyte in all associated samples shall be qualified as estimated (“JH”), whereas nondetect results shall be considered acceptable for use without qualification.

- If the matrix spike recovery for an analyte is less than 70% but greater than or equal to 30%, suggesting a potential low bias in reported results, positive and nondetect results for that analyte in all associated samples shall be qualified as estimated (“JL” or “UJL”).
- If the matrix spike recovery for an analyte is <30%, positive sample results shall be qualified as estimated (“JL”), whereas nondetect results shall be qualified as unusable (“R”) for all associated samples.

A qualifier code of “MS” shall be assigned to all results qualified as estimated or rejected on the basis of matrix spike recoveries.

D.2.1.2.2.1.6 Field Duplicate Agreement

Criteria for evaluating field duplicate results are not provided in the Functional Guidelines. Therefore, the following criteria shall be used for reviewing homogenized or collocated field duplicate results for all analyses. When both the sample and duplicate values are greater than or equal to five times the MQL, acceptable sampling and analytical precision is indicated by a relative percent difference (RPD) of less than or equal to 50 percent (30 percent for aqueous samples). When the results for analytes in one or both of the field duplicate pair samples are detected and one or both results are less than five times the MQL, satisfactory precision is indicated if the absolute difference between field duplicate results is less than 3.5 times the higher SDL in solid samples and two times the higher SDL for aqueous samples. Note: When one of the results for the field duplicate pair is reported as not detected in the sample at less than the value of the SDL, the full value of the SDL is used to calculate the absolute difference between the field duplicate results. If the above criteria are not met for an analyte, all associated sample data for that analyte shall be qualified as estimated (“J/UJ”). When both results for the field duplicate pair are reported as less than the SDL, the precision is not evaluated.

D.2.1.2.2.1.7 Anion/Cation Balance

Since water is generally electrically neutral, the sum of the dissolved cation concentrations (expressed in milliequivalents per liter) shall equal the sum of the dissolved anion concentrations. For projects in which the major cations and anions are being analyzed, the person reviewing the data shall evaluate whether there is an acceptable balance between anion concentrations and cation concentrations. In accordance with Standard Methods #1030F, the equation used to calculate anion-cation balances is:

$$\% \text{ Difference} = 100 \times \left(\frac{\sum \text{cations} - \sum \text{anions}}{\sum \text{cations} + \sum \text{anions}} \right)$$

Laboratory accuracy control limits for most analytes are $\pm 30\%$. This level of accuracy is considered to be fully acceptable in meeting the end use objectives of groundwater monitoring. A 30% bias in the metals analysis corresponds to an anion-cation balance percent difference of approximately 13%. Therefore, since a 30% bias is considered not to adversely affect the usability of the data, an evaluation criterion of a percent difference less than $\pm 13\%$ shall be utilized for anion-cation balance evaluation. If the anion/cation balance is greater than $\pm 13\%$, the person reviewing the data shall use professional judgment to discern likely causes of the imbalance and need for qualification of data.

D.2.1.2.2.1.8 Balance of Total to Partial Analyses

Results for the total analysis of a particular analyte shall be greater than the results for a partial analysis of that analyte. For example, the results for total metals shall be greater than, or equal to, the results for dissolved metals, and ammonia concentrations shall not be greater than Total Kjeldahl Nitrogen concentrations. Because all results are limited by the accuracy of the analysis, the criteria for accuracy of the analysis shall be used as the basis for criteria to evaluate the agreement between the results for the partial analysis and the total portion. Where both of the results are greater than five times the higher MQL, the criterion utilized shall be that the two values shall agree within $\pm 30\%$. For example, the partial analysis result shall not be more than 30% higher than the total analysis result. Where either of the results is less than five times the MQL, an evaluation criterion of plus or minus two times the higher SDL is compared against the difference between the partial and total results. If the results for the partial versus total analyses do not satisfy the appropriate evaluation criterion, results for the partial and total analyses are qualified as estimated ("J/UJ").

D.2.1.2.2.2 Organic Analyses

For organics by GC or GC/mass spec, the data shall be evaluated from the reported results for the following sample-specific criteria using the specifications given below and the criteria from Table D.1.1-1:

- Holding times;
- Blank results;
- Laboratory control sample analyses;
- Surrogate recovery results;
- Matrix spike/matrix spike duplicate analyses;
- Internal standard recoveries for isotope dilution GC/mass spec analyses;
- Tentatively identified compounds; and
- Field duplicate result agreement.

The person reviewing the data shall use guidance from EPA's Functional Guidelines to address issues not covered by Element D of the QAPP.

D.2.1.2.2.2.1 Holding Times

The holding times shall be compared to the holding time requirements specified in Element B.2.2, Table B.2.2-1. If no holding time requirements are specified in the QAPP, the holding time requirements specified in the method should be used to evaluate the data. Results for analyses not performed within holding time limits shall be qualified as estimated ("J/UJ"). If the holding time is grossly exceeded (more than two times the holding time limit), the person reviewing the data shall use professional judgment to evaluate the need to reject non-detected results.

A qualifier code of "HT" shall be assigned to all results qualified or rejected on the basis of holding times.

D.2.1.2.2.2.2 Blank Results

The results for method blanks, field and trip blanks, rinsate blanks, and other blanks reported in the data package shall be reviewed. If the associated sample matrix is a solid, positive rinsate, calibration, and other associated aqueous blank, results shall be converted to equivalent concentrations in the solid samples by assuming that all contamination found in the aqueous blank aliquot analyzed is potentially present at up to five times that amount in the solid sample aliquot analyzed. Sample results for analytes detected in an associated blank at concentrations less than five times (ten times for the common laboratory contaminants: methylene chloride, acetone, 2-butanone, cyclohexane, and phthalates) the equivalent blank concentration shall be qualified as non-detect ("U") at the reported concentration. A method blank is associated with all samples prepared with that blank.

If the LRC documents an exception report for Item R5, because the concentration of the analyte, unadjusted for sample specific factors, in an environmental sample was greater than 10 times the concentration of the analyte detected in a laboratory blank sample, the analytical result shall be considered detected in the sample and not qualified "U".

A qualifier code of "MB", "FB", "RB" or "TB" shall be assigned to all results qualified on the basis of method blank, field blank, rinsate blank, or trip blank results, respectively.

D.2.1.2.2.2.3 Laboratory Control Sample Analysis

The analyte recoveries obtained for LCS analyses shall be compared to the acceptance range contained in Table D.1.1-1 (60-140%). All target analytes shall be spiked into the LCS. Data associated with LCS recoveries outside the acceptance range shall be qualified as follows:

- If the LCS recovery for an analyte is greater than 140%, suggesting a potential high bias in reported results, all positive results for that analyte in all associated samples shall be qualified as estimated (“JH”), whereas nondetect results shall be considered to be acceptable for use without qualification.
- If the LCS recovery for an analyte is less than 60% but greater than or equal to 10%, suggesting a potential low bias in reported results, positive and nondetect results for that analyte in all associated samples shall be qualified as estimated (“JL” or “UJL”).
- If the LCS recovery for an analyte is <10%, positive sample results shall be qualified as estimated (“JL”) whereas nondetect results shall be qualified as unusable (“R”) for all associated sample results.

A qualifier code of “LCS” shall be assigned to all results qualified or rejected on the basis of LCS recoveries.

D.2.1.2.2.2.4 Surrogate Recovery Results

The surrogate recoveries obtained for each sample analysis for which surrogates were analyzed shall be compared to the acceptance range contained in Table D.1.1-1 (60-140%). Results for analytes in the sample associated with surrogate recoveries outside the acceptance range shall be qualified as follows:

- If the surrogate recovery is greater than 140% for any surrogate (for semivolatile organics by GC/mass spec, two or more surrogates in either fraction shall be high), suggesting a potential high bias in reported results, all positive results for that associated analytes in that sample shall be qualified as estimated (“JH”), whereas non-detect results shall be considered to be acceptable for use without qualification.
- If the surrogate recovery is less than 60% but greater than or equal to 10% (for semivolatile organics by GC-mass spec, two or more surrogates in either fraction are out with at least one of them being less than the lower limit but >10%), suggesting a potential low bias in reported results, positive and nondetect results for associated analytes in that sample shall be qualified as estimated (“JL” or “UJL”).
- If any surrogate recovery is <10%, positive results for associated analytes in that sample shall be qualified as estimated (“JL”), whereas associated non-detect results shall be qualified as unusable (“R”).

A qualifier code of “SUR” shall be assigned to all results qualified or rejected on the basis of surrogate recoveries.

D.2.1.2.2.2.5 Matrix Spike/Matrix Spike Duplicate Sample Analysis

The analyte recoveries obtained for MS/MSD analyses shall be compared to the acceptance range contained in Table D.1.1-1 (60-140%) for cases in which the native sample concentration is less than four times the spike concentration. When the sample concentration of an analyte is greater than four times the spiking concentration, the result is considered to be inappropriate for assessing accuracy. Data associated with matrix spike or matrix spike duplicate recoveries outside the acceptance range shall be qualified as follows:

- If the matrix spike recovery for an analyte is greater than 140%, suggesting a potential high bias in reported results, all positive results for that analyte in the sample used for the matrix spike analysis shall be qualified as estimated (“JH”), whereas nondetect results shall be considered to be acceptable for use without qualification.
- If the matrix spike recovery for an analyte is less than 60% but greater than or equal to 10%, suggesting a potential low bias in reported results, positive and nondetect results for that analyte in the sample used for the matrix spike analysis shall be qualified as estimated (“JL” or “UJL”).
- If the matrix spike recovery for an analyte is <10%, positive sample results in the sample used for the matrix spike analysis shall be qualified as estimated (“JL”), whereas nondetect results shall be qualified as unusable (“R”) for all associated samples.
- No qualification of associated samples in the batch or data package shall be performed on the basis of matrix spike recoveries alone. The person reviewing the data shall use professional judgment and consider the results of other QC measures, such as surrogate recoveries in conjunction with MS/MSD results, to determine the need for qualification of associated samples.
- The RPDs between the matrix spike and the matrix spike duplicate shall be compared to the 40% acceptance criteria contained in Table D.1.1-1. If the MS/MSD RPD for an analyte does not satisfy the evaluation criterion, results for that analyte in the sample used for the matrix spike analysis shall be qualified as estimated (“J/UJ”). The person reviewing the data shall use professional judgment and consider the results of other QC measures in conjunction with MS/MSD results to determine the need for qualification of associated samples.

A qualifier code of “MS/SD” shall be assigned to all results qualified on the basis of MS/MSD precision.

D.2.1.2.2.2.6 Tentatively Identified Compound Identification

Tentatively Identified Compound identification may be required for volatile or semivolatile organic compound analysis by GC/mass spec. Qualification of TIC results shall be performed based on the following:

- All TIC results shall be qualified “NJ”, tentatively identified with approximated concentrations.
- If it is determined that a tentative identification of a non-target compound is not acceptable, the tentative identification shall be changed to “unknown” or to an appropriate identification.
- If TIC concentrations are attributable to laboratory contamination, based on the criteria specified above for evaluating blank results, line-out the identification of the TIC (the compound shall not be considered a TIC).

D.2.1.2.2.2.7 Field Duplicate Agreement

Criteria for evaluating field duplicate results are not provided in the Functional Guidelines. Therefore, the following criteria shall be used for reviewing homogenized or collocated field duplicate results for all analyses. When both the sample and duplicate values are greater than or equal to five times the MQL, acceptable sampling and analytical precision is indicated by a relative percent difference (RPD) for the two field duplicate results of less than or equal to 50% (30% for aqueous samples). When the results for analytes in one or both of the field duplicate pair samples are detected and one or both results are less than five times the MQL, satisfactory precision is indicated if the absolute difference between field duplicate results is less than 3.5 times the higher SDL in solid samples and two times the higher SDL for aqueous samples. When one of the results for the field duplicate pair is not detected in the samples and the results are reported as less than the SDL, the full value of the SDL is used to calculate precision. If the above criteria are not met for an analyte, all associated sample data for that analyte shall be qualified as estimated (“J/UJ”). When both results for the field duplicate pair are reported as less than the SDL, the precision is not evaluated.

D.2.1.2.2.2.8 Other Analyses

For other analyses, data review shall consist of the following applicable items, as defined by the QC acceptance criteria contained in Section 6 of the FSP. If no QC criteria are included in Section 6 of the FSP, then the method QC criteria should be used to evaluate the following items:

- Evaluation of compliance to holding time limits, with data outside of the holding time limits qualified as estimated (or rejected if in the professional judgment of the reviewer the data are unusable).

- Evaluation of spike recoveries (laboratory control sample and matrix spikes) and duplicate analysis precision (field duplicates, matrix spike duplicates, or laboratory duplicates) with data outside of the accuracy and precision limits qualified as estimated, "J/UJ" (or rejected, "R," if in the professional judgment of the reviewer the data are unusable). If the given QC result indicates that associated sample results have a potential high bias, associated results reported as not detected do not require qualification.
- Evaluation of field blank contamination with qualification of data from samples associated with contaminated blanks using the following guidance adapted from the Functional Guidelines.

Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. No positive sample results shall be reported unless the concentration of the analyte in the sample exceeds five times the amount in any blank. In instances where more than one blank is associated with a given sample, qualification shall be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results shall not be corrected by subtracting any blank value. Specific actions are as follows:

1. If a compound is found in a blank, but not found in the sample, no action is taken.
2. If a blank has a positive result for an analyte, qualify associated sample data as follows:

If the sample result is greater than the laboratory method quantitation limit but less than five times the blank concentration, flag the sample result as a non-detect ('U'). If the sample result is reported as detected at a concentration less than the sample detection limit and less than five times the blank concentration, qualify the sample result as not-detected at the sample detection limit. If the sample result is greater than or equal to five times the blank concentration, no action is taken. For aqueous blanks applied to soil/sediment samples, qualification is assigned based on comparison of the sample result to the equivalent concentration of the blank. The equivalent concentration is determined by assuming that all of the analyte present in the blank aliquot analyzed is present in the sample aliquot analyzed.

The reviewer shall note that the blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. These factors shall be taken into consideration when applying the five times criteria, such that a comparison of the total concentration is actually made.

D.2.1.2.3 Review of Field Data

All field data should be verified at the time of collection by following the QC checks given in the QAPP and site-specific FSP. The data reviewer shall review the field data

documentation to identify discrepancies or unclear entries. Field data documentation should be evaluated against the following criteria, as appropriate:

- Sample location and adherence to the field sampling plan
- Field instrumentation and calibration
- Sample collection protocols
- QC measures employed
- Quality assurance objectives achievement

D.2.1.3 *Process for Data Validation*

Validation of project data will be performed at the frequency specified in Section 3 of the FSP. Data validation is implemented to provide a quality check on the laboratory system generating the data. All of the QC results which were reported on the laboratory test reports (or summary forms) as being outside of the acceptance criteria shall be checked against the LRC to evaluate whether problems were identified and reported. Ten percent of the data in the data packages being validated shall be checked for transcription errors and calculation errors. If systematic or frequent errors are encountered, 100 percent of the data packages shall be reviewed for errors analogous to those identified in the initial review.

In addition to the data review described in Element D.2.1.2, the independent data reviewer shall perform a validation of the project analytical batches at the frequency specified in Section 3 of the FSP, including any analytical batches containing split sample analyses from a second laboratory. The criteria specified in Elements D.2.1.2.1.1 through D.2.1.2.1.8 shall be used to evaluate the laboratory performance criteria and those sample specific data included in the supporting data designated as items S1 through S9 on the LRC. If a criterion is not covered in these elements (e.g., relative response factors, correlation coefficients, tuning criteria), the data reviewer shall use professional judgment in evaluating and qualifying the associated data using guidance from the National Functional Guidelines, as applicable to the analytical method. If TICs were reported, the tentative identification shall be checked against the mass spectra and the chromatograms.

Prior to selecting the data for validation, the project objectives should be reviewed to ensure that any samples critical to the decision process can be identified and given priority, if necessary. The results of the data validation shall be conveyed to the data user(s) in the DUS as described in Element D.2.3.1 below.

D.2.2 Resolution Procedures and Responsible Individuals

During the data review process, situations may be encountered that warrant corrective action. Corrective actions may involve an increased level of data review, reanalysis, or resampling.

D.2.2.1 *Additional Data Review*

If a review of the required reportable data indicates the need for more in-depth data review, additional data review may include, at the discretion of the TCEQ, a review of some or all of the laboratory performance criteria for 100% of the data packages for a given phase of the project. The data review performed by the analytical laboratory includes a thorough review of laboratory performance criteria (which are independent of the field samples being analyzed). Any laboratory performance criteria results not meeting QC acceptance criteria are documented by the laboratory in the LRC and associated ERs. Examples of problems identified during review that could trigger additional review of the laboratory performance criteria include:

- Items identified as being outside QC acceptance criteria by the **independent** data reviewer but not identified by the laboratory in the LRC and associated ERs. Such a situation would suggest that the LRC may not be a reliable indicator of difficulties encountered during analysis that could potentially adversely affect data quality.
- Failure to meet acceptance criteria on performance evaluation samples or laboratory control samples. This would suggest that the given analyses may not be fully within the laboratory's control.
- Zero percent surrogate recoveries or matrix spike recoveries on organics analyses. This could be an indication that the peaks for the standards fell outside retention time windows, which might be discernable through evaluation of the chromatograms. It could also be an indication of coeluting interferences (unresolved hump) obscuring proper identification of the peaks due to the standards.
- Failure to meet QC acceptance criteria on samples known to be relatively "clean" such as equipment rinsate or field blanks.
- Inconsistent results, such as homogenized field duplicate sample results differing greatly, identification of contaminants at a site not expected based on the site history and processes, or concentrations of analytes or identification of contaminants inconsistent with historic data from the same location/medium.
- Poor anion/cation balance calculation results for aqueous samples or situations where dissolved metal results exceed total metals results by more than what would be expected from normal analytical variability.

The data reviewer is responsible for communicating with the laboratory(s). The laboratory(s) will be contacted with regard to any missing or incorrect deliverables in the data packages noted during the review process. The data reviewer will document all subsequent submittals and resubmittals from the laboratory, recalculations, and data reviewer corrections. The data reviewer shall summarize the results of the data review and the impact on the quality and usability of the data in the DUS as described in Element D.2.3.1.

D.2.2.2 *Reanalysis*

During the data review and usability evaluation, individual sample analysis results may have been rejected or identified as unusable. If such data include results considered crucial to meeting project objectives, it is likely that resampling or reanalyses shall be required. For example, if the DUS identifies a data point as having too high a level of uncertainty to demonstrate compliance with an action level or LORP, and the data point is critical to making a decision, then an evaluation shall be conducted to determine whether reanalysis or resampling/reanalysis is likely to improve the situation.

D.2.2.3 *Procedures for Corrective Actions and Documenting Corrective Actions Taken*

All corrective actions based on review and/or validation of the data shall be documented in the project files and shall include the resolution of each corrective action.

D.2.3 Method of Conveying Results of the Independent Review

D.2.3.1 *Data Review Memorandum*

Upon completion of the data usability review, the Contractor shall prepare a data review memorandum. The data review memorandum shall briefly summarize the results of the data usability review and identify issues and concerns encountered during the data usability review, including any significant QC problems or anomalies, rejected data, and any corrective action taken or any recommended corrective action to be implemented for future analyses.

Additionally, the data review memorandum shall address the usability of the data relative to the project objectives, and shall include a discussion of the effect of the uncertainty associated with results qualified as estimated and an evaluation of the adequacy of the sample detection limits for non-detected results and the method quantitation limits relative to the action levels or levels of required performance.

The data review memorandum shall include the following attachments:

- Analytical results in tabular format with the final data review qualifiers and qualifier and bias codes in accordance with the criteria given in QAPP Element D.1.1;
- A copy of the detailed results of the data usability review as described in the “Data Review/Validation Results” subsection of QAPP Element D.2.3.2.1;
- A CD ROM containing the laboratory performance criteria (supporting data) in Adobe Acrobat (PDF) file format.

D.2.3.2 *Data Usability Summary*

The person reviewing and validating the data shall prepare a DUS that describes the results of the data review and validation effort and summarizes the usability of the data in meeting the specific project objectives. The DUS shall discuss what QC measures were reviewed and validated, how these measures were reviewed or validated, the evaluation criteria used in the review and validation, all items identified as falling outside the evaluation criteria, the specific data potentially affected, and the potential effect on the quality of the associated data. Attachment 2 contains an example of a completed DUS. Figure D.2-1 below shows the required table of contents for a DUS. A brief summary of the contents required for each section of the DUS is provided in Element D.2.3.2.1 below.

D.2.3.2.1 Contents/Scope/Description of the DUS

The table of contents for the DUS is presented in Figure D.2-1.

TLAP LABORATORY ACCREDITATION CERTIFICATION STATEMENT INTRODUCTION

LABORATORY REVIEW CHECKLIST REVIEW CRITERIA

FIELD DATA AND LABORATORY DATA PACKAGE REVIEW CRITERIA

DATA VALIDATION CRITERIA

DATA REVIEW/VALIDATION RESULTS

Data package 1234

Data package 1235

Data package etc

OVERALL ASSESSMENT OF THE DATA

DATA USABILITY RELATIVE TO PROJECT OBJECTIVES

Sample Detection Limits and Decision Criteria Comparison

Effects of Potential Biases and Imprecision on Usability of the Data

Representativeness Evaluation

POTENTIAL ADDITIONAL DATA USES AND LIMITATIONS

CORRECTIVE ACTIONS AND WORKPLAN DEVIATIONS

Corrective Actions

Deviations from the QAPP, site-specific FSP, and SOPs

REJECTED DATA AND PROJECT CONSEQUENCES

CONCLUSIONS

APPENDIX A - CERTIFICATES OF ANALYSIS AND SUMMARY FORMS

A.1 Data Reports for Data Package 1234

A.2 Data Reports for Data Package 1235

A.3 Data Reports for Data Package etc.

APPENDIX B - CUSTODY FORMS

APPENDIX C - LABORATORY REVIEW CHECKLISTS AND EXCEPTION REPORTS

APPENDIX D - LABORATORY NELAP ACCREDITATION CERTIFICATE

Figure D.2.3.2-1 Table of Contents for DUS

Specifically, the contents of the DUS are:

TLAP LABORATORY ACCREDITATION CERTIFICATION STATEMENT

The Contractor (or consultant representing the PRP) shall include a statement in this section of the DUS that at the time the laboratory data were generated for the project, the laboratory was accredited under the Texas Laboratory Accreditation Program (TLAP) for the matrices, methods, and parameters of analysis and/or clearly identify laboratory data where one of the regulatory exceptions specified in 30 TAC §25.6 applied to the project. In addition, this section shall include a copy of the laboratory's National Environmental Laboratory Accreditation Program (NELAP) accreditation certificate applicable to the period during which the project data were generated.

INTRODUCTION

This section of the DUS provides a description of the data that were reviewed and validated and identifies the project for which the review was performed and the contents of the DUS. This section shall include a table cross-referencing the laboratory identification number to field identification numbers and shall identify all field QC samples submitted blind to the laboratory. The QC sample descriptions shall include specification of samples associated with the given QC sample. For example, for a field duplicate, the description shall indicate the sample for which the QC sample is a duplicate and the samples for which the duplicate agreement results are considered applicable. Another example would be that for a rinsate sample, the text shall describe the sample location at which the rinsate was taken and the samples associated with the rinsate blank that were collected with the same type of sampling equipment.

LABORATORY REVIEW CHECKLIST REVIEW CRITERIA

This section of the DUS provides a concise summary of the criteria used to review the LRC. This section provides a description of the QC measures reviewed, how these measures were reviewed, and the evaluation criteria used to review items identified in the LRC that are not part of the reportable data. The portions of this section that are not project-specific may be taken directly from the text of Element D.2.1.2.

FIELD DATA AND LABORATORY DATA PACKAGE REVIEW CRITERIA

This section contains a concise summary of criteria used to review field analytical results and the laboratory data package and a summary of criteria used to review the data.

This section provides a description of the QC measures reviewed, how these measures were reviewed, and the evaluation criteria used to review the data reported in the laboratory data package. The portions of this section that are not project-specific may be taken directly from the text of Element D.2.1.2.

DATA VALIDATION CRITERIA

This section of the DUS provides a concise summary of the criteria used to validate the data. This section provides a description of the QC measures validated, how these measures were validated, and the evaluation criteria used in the data validation. These criteria may be specific to the project.

DATA REVIEW/VALIDATION RESULTS

This section provides the results of the review conducted on both the laboratory data package and the LRC. This section shall also include the results of the data validation. This section shall indicate all items identified as falling outside the evaluation criteria described in the previous three sections, the specific data potentially affected, and the potential effect on the quality of these associated data. All professional judgment used in making decisions concerning qualification of data associated with QC measures outside acceptance criteria shall be documented in this section. It is acceptable for this section to contain descriptions only of those QC measures failing to meet acceptance criteria, as long as the text specifically indicates that all other QC measures specified for review in Element D.2.1 met acceptance criteria for data review.

This section of the DUS shall contain a description of the reason for qualification and the direction of potential bias or imprecision (if known). Data review procedures shall involve assignment of qualifier codes to each result qualified or rejected during data review. These qualifier codes shall reflect the reason for qualification as well as the potential direction of bias. For example, "JL-MS" would mean the result was qualified for matrix spike recoveries outside of evaluation criteria resulting in a potential low bias in the reported value. Qualifiers and qualifier codes to be used are described in more detail in Element D.1.1 above and listed in Tables D.1.1-2 and D.1.1-3, respectively. If additional user-defined codes are used, they shall be defined specifically in this section of the DUS.

OVERALL ASSESSMENT OF THE DATA

An overall assessment of the data relative to the quantitative and qualitative data quality assurance parameters is provided in this section.

DATA USABILITY RELATIVE TO PROJECT OBJECTIVES

A systematic planning process shall be used in designing the sampling and analysis plan for a given project. Specific project objectives, decisions that are anticipated to be required to meet the project objectives, and the criteria by which these decisions are anticipated to be made are defined in Section 1 of the FSP. This section of the DUS shall restate the project objectives and describe the effect of the uncertainty associated with results qualified as estimated which may affect the usability of the data in terms of making a meaningful comparison to the project objectives, such as

comparing results to an action level or LORP. For example, if a given result was 30% below an action level to which it is to be compared, but the data review indicated that the result had a potential low bias with an estimated magnitude of 60% (e.g., surrogate spike recovery = 40%), then the data point would not be sufficient to conclude confidently that the result was below the action level. If on the other hand the action level or LORP is two orders of magnitude higher than the reported result, the same data point would be considered sufficient to conclude confidently that the result was below the action level.

This section of the DUS shall also include requirements for comparison of sample detection limits to action levels or LORPs to evaluate whether or not results reported as non-detected have sufficient sensitivity to demonstrate absence of the analyte above the action level or LORP. Potential biases and imprecisions in sample detection limits for non-detected results qualified as estimated shall also be considered in comparisons to the action levels or LORPs.

The text shall include an evaluation of how representative the analytical results are of the medium being evaluated based on measures such as sampling design, replicate analyses, etc. It shall also include discussion on the sufficiency of the valid data set in meeting project objectives.

POTENTIAL ADDITIONAL DATA USES AND LIMITATIONS

This is an optional section that shall describe the usability of the analytical data for additional end uses and in particular shall summarize the major limitations of the data. The example DUS provided in Attachment 2 contains text for risk assessment as a potential additional end use of the data for a circumstance in which the data were being collected to make decisions using criteria other than risk assessment, but it was reasonably foreseeable that the data might ultimately be used in a risk assessment.

CORRECTIVE ACTIONS AND WORKPLAN DEVIATIONS

This section of the DUS shall describe any deviations from the QAPP, site-specific FSP, and SOPs and the potential effects of these deviations on the quality of the associated data and its usability in meeting the end use objectives. This section shall also describe all corrective actions that were implemented in response to a failure to meet QC criteria or deviations from this QAPP, the site-specific FSP, and SOPs.

In particular, this section shall include a complete description of problems encountered during field sample collection; failures in following prescribed sampling, field analysis, and custody procedures; and an evaluation of the potential effect on the quality of the data or on how representative the samples collected are of the medium being characterized.

REJECTED DATA AND PROJECT CONSEQUENCES

This section of the DUS shall contain a listing of all data that have been considered to be unusable in meeting the specific project objectives. It shall also provide a detailed discussion of whether any of the rejected or unusable data are considered critical to meeting project objectives and what the specific project consequences are of having these rejected or unusable data.

CONCLUSIONS

This section of the DUS shall summarize the conclusions reached during review and an evaluation of data usability.

APPENDICES

The laboratory data packages, including the LRCs and associated ERs, shall be included as an appendix to the DUS. The test reports annotated with the final data review qualifiers and associated qualifier codes and bias codes shall also be included. Each reviewed test report shall be initialed and dated by the person who performed the review. The appendices shall also contain copies of the custody forms, if these are not included as part of the laboratory data package.

D.3 Reconciliation with User Requirements

A systematic planning process shall be used in designing the sampling and analysis plan for a given project. Specific project objectives, decisions that are anticipated to be required to meet those project objectives, and the criteria by which those decisions are anticipated to be made are specified in Section 1 of the FSP.

The DUS shall describe the effect of the uncertainty associated with results qualified as estimated which may affect the usability of the data in making a meaningful comparison to the project objectives, such as comparing results to an action level or LORP. The DUS shall also include requirements for comparison of sample detection limits to action levels or LORPs to evaluate whether or not results reported as non-detected have sufficient sensitivity to demonstrate absence of the analyte above the action level or LORP.

Potential biases and imprecision in sample detection limits for non-detected results qualified as estimated also shall be considered in comparisons to the action levels or LORPs. The text shall include an evaluation of how representative the analytical results are of the medium being evaluated based on measures such as sampling design, replicate analyses, etc. It shall also include discussion on the sufficiency of the valid data set in meeting project objectives.

The DUS shall describe deviations from the site-specific FSP, QAPP and SOPs and the potential effects of these deviations on the quality of the associated data and its

usability in meeting the end use objectives. The DUS shall also describe all corrective actions that were implemented in response to a failure to meet QC criteria or deviations from the site-specific QAPP or project plan and SOPs.

In particular, the DUS shall also include a complete description of problems encountered during field sample collection; failures in following prescribed sampling, field analysis, and custody procedures; and an evaluation of the potential effect on the quality of the data or on how representative the samples collected are of the medium being characterized.

The DUS shall also contain a listing of all data that have been rejected during data review or that have been considered to be unusable in meeting specific project objectives. It shall also provide a detailed discussion of whether any of the rejected or unusable data are considered critical to meeting project objectives and what the specific project consequences are of having these rejected or unusable data.

D.3.1 TCEQ Project Manager Responsibilities

The TCEQ PM responsibilities, with respect to laboratory data review and the usability evaluation, are described below. A checklist listing these responsibilities is provided in Attachment 3.

D.3.1.1 *Review and Interpretation of the Laboratory Review Checklist*

Review and interpretation of the LRC is performed by the person reviewing the data and reported in the DUS. The TCEQ PM or designee shall perform a spot check of selected LRCs to provide assurance that the items contained therein are in agreement with the reportable data included in the laboratory data package and adequately addressed in the DUS.

D.3.1.2 *Review and Interpretation of the DUS*

The TCEQ PM shall perform a technical review of the DUS and the associated laboratory data packages, or alternatively the project QAS shall perform an audit of data quality on the DUS and associated data packages at the request of the TCEQ PM. At a minimum, this review or audit shall address the following items:

- The TCEQ PM or project QAS shall verify that at the time the laboratory data were generated for the project, the laboratory was accredited under the Texas Laboratory Accreditation Program (TLAP) for the matrices, methods, and parameters of analysis or one of the regulatory exceptions specified in 30 TAC §25.6 applied to the project.

- The TCEQ PM or project QAS shall review the completeness of the DUS against the criteria contained in Element D.2.3.2 of this QAPP or the TCEQ PM Review Checklist in Attachment 3.
- The TCEQ PM or project QAS shall assess the performance of the person reviewing the data by reviewing some of the reportable and supporting data to ensure that the data were appropriately treated in the DUS.
- The TCEQ PM or project QAS shall evaluate the data usability determination performed by the person reviewing the data to ensure that the usability determination relative to action levels or LORPs has been performed appropriately. Particular care shall be taken to evaluate the appropriateness of the data usability determination relative to project end use objectives to ensure that the end use objectives (action levels, LORPs, etc.) are appropriate to the project, that the evaluation of the magnitude of uncertainty is consistent with the QC measure results, and that items identified in the LRC are appropriately addressed in the DUS.
- The TCEQ PM or project QAS shall assure him/herself that the person has completed all aspects of the data review/data usability determination required by Element D of the QAPP.

The TCEQ PM or project QAS shall assure him/herself that all data that were either rejected or considered unusable for meeting project objectives are either: 1) not crucial to meeting project objectives; or 2) the need for resampling or reanalysis has been identified and provisions proposed to fill the data gaps in a manner that will meet the project objectives.

D.3.2 TCEQ QA Specialist Responsibilities

The TCEQ project QAS shall serve primarily as a technical resource to the TCEQ PM in interfacing with the various involved parties, such as the Potentially Responsible Parties (PRPs) and/or their representatives, TCEQ Contractors or PRP consultants, and laboratories. The project QAS responsibilities are generally limited to complex, technical QA/QC or analytical chemistry issues, and the project QAS is not expected to be involved in routine project management tasks. At the request of the TCEQ PM, the project QAS will also perform an audit of data quality on the DUS and, if warranted, provide additional data review services. If a given laboratory is used on multiple projects through different consultants, the project QAS may also evaluate whether the laboratory appears to be experiencing systematic problems in meeting some QC acceptance criteria for laboratory performance criteria that might warrant review of laboratory performance criteria from other projects using the same laboratory.